Engineering Library

The Engineer.

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VOL. CXLVIII.—No. 3856] LONDON: FRIDAY EVENING, DECEMBER 6, 1929 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General,
India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
2 SALOON UNDERFRAMES and BOGIES.
Tenders due 31st December, 1929.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 3916

West Bromwich Education COMMITTEE.
KENRICK TECHNICAL COLLEGE.
Principal : R. C. PRESCOTT, M.Sc., M.I. Mech. E.
DAY TECHNICAL SCHOOL.
APPLICATIONS are INVITED for the POST of LECTURER in ENGINEERING at the above College. Candidates should possess an Honours Degree in Mechanical Engineering, with some knowledge of Electrical Engineering. Salary will be according to the Burnham Scale.
Particulars and application form for the post may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope. Applications should be received not later than 14th December.
ARTHUR LEWIS,
Director of Education.
Education Offices, West Bromwich,
27th November, 1929. 3861

The Institution of Chemical ENGINEERS.
EXAMINATION, 1930.
Application forms (returnable 23rd December, 1929) and particulars of the Associate Membership Examination for 1930, together with the Memorandum on "The Training of a Chemical Engineer," may be obtained from the HON. REGISTRAR, Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1. 3715

Bengal-Nagpur Railway COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for :
1450 CARRIAGE AND WAGON TYRES.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Tuesday, 3rd December, 1929.
A fee of 20s. will be charged for each copy of the specification, which is not returnable.
Tenders must be submitted not later than Noon on Friday, 13th December, 1929.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
3869 Secretary.

Brentford Union.
TENDERS.
The Guardians invite TENDERS for the SUPPLY and ERECTION of :—
A STEAM DISINFECTOR at their West Middlesex Hospital, Isleworth.
Full particulars, together with drawings and specification, to be obtained from the undersigned.
Tenders must be received by the 22nd January, 1930.
By Order,
F. E. HARMSWORTH,
Clerk to the Guardians.
Toolands House,
34, Twickenham-road, Isleworth, Middlesex.
2nd December, 1929. 3893

PUBLIC HEALTH ACT, 1875.
Corporation of Salisbury, WILTSHIRE.
TO REINFORCED CONCRETE CONTRACTORS.
The Corporation, acting as the Sanitary Authority for the said District, are prepared to receive TENDERS for a REINFORCED CONCRETE BRIDGE. The works will comprise the Approach to the Bridge, together with Ancillary Works.
Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Monday, the 16th of December, 1929, until Monday, the 23rd of December, 1929, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Three Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.
The successful tenderer will be required to execute a contract and bond in a form to be prepared by the undersigned.
Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Bridge over River Avon." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.
Each Tender must be signed in the handwriting of the tenderer or his authorised agent.
The Corporation does not bind itself to accept the lowest or any Tender.
Tenders must reach the undersigned by 9 a.m. on Monday, the 6th of January, 1930.
Given under my hand the 2nd day of December, 1929.
A. SMART,
Clerk to the Corporation of Salisbury.
The Council House,
Salisbury, Wiltshire. 3898

Parish of Bermondsey.
TO ENGINEERS.
The Guardians of the Parish of Bermondsey invite TENDERS for SUPPLYING CALORIFIERS, PIPING, &c., at the Ladywell Institution, Ladywell-road, S.E. 13, according to the specification of Messrs. Newman and Newman, Architects.
Persons desirous of tendering may inspect the articles of agreement and obtain printed forms of Tender (which can only be received) and copies of specification at my office between 10 a.m. and 12 Noon on the 5th, 6th, and 9th December, 1929.
Sealed Tenders to be delivered to me at my office not later than 6 p.m. on Thursday, the 12th December, 1929.
By Order,
HENRY H. REEVE,
Clerk.
Guardians' Offices,
283, Tooley-street, London, S.E. 1,
30th November, 1929. 3871

The Engineer

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PUBLIC NOTICES

Corporation of Dublin.
TENDERS are INVITED for a PORTABLE POWER-DRIVEN SAND ELEVATOR.
Particulars of requirements and conditions of contract may be obtained on application to the Borough Surveyor, 28, Castle-street, Dublin.
Sealed Tenders, endorsed "Tender for Sand Elevator," should be lodged in my office not later than Twelve Noon on Monday, 16th December, 1929.
GERALD J. SHERLOCK,
Town Clerk.
City Hall, Dublin,
30th November, 1929. 3918

Metropolitan Water Board.
TENDERS FOR THE SUPPLY OF FOUR STEAM TURBINES WITH CENTRIFUGAL PUMPS AND TWO ELECTRIC GENERATORS AT THE SURBITON PUMPING STATION, PORTSMOUTH-ROAD, SURBITON, SURREY.
The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of FOUR STEAM TURBINES with CENTRIFUGAL PUMPS and TWO ELECTRIC GENERATORS at their Surbiton Pumping Station, Portsmouth-road, Surbiton, Surrey.
Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the offices of the Board, Chief Engineer's Department (Room 173), on and after Wednesday, 11th December, 1929.
Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Three Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Turbines, Surbiton," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 21st January, 1930.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
3rd December, 1929. 3909

PUBLIC NOTICES

Parish of St. Mary, Islington.
TO MANUFACTURERS OF ELECTRIC LIFTS.
The Guardians of the Poor of the Parish of St. Mary, Islington, in the County of London, invite TENDERS from persons willing to contract for the SUPPLY and ERECTION of FIVE FULL AUTOMATIC PUSH-BUTTON ELECTRIC LIFTS at their Infirmary, Highgate Hill, N. 19, in accordance with a specification prepared by their Consulting Engineers, Messrs. Couzens and Brown, of 9, Old Queen-street, London, S.W. 1.
The specification, conditions of contract and form of Tender may be inspected at the offices of the Consulting Engineers as above, and a copy of the specification and form of Tender may be obtained from the 6th December to the 20th December, 1929, from the Clerk to the Guardians, Parish of St. Mary, Islington, Guardians' Offices, St. John's-road, Upper Holloway, London, N. 19, upon payment of a deposit of £2, which will be returned upon receipt of a bona fide Tender.
Tenders must be signed, sealed up and addressed to the Guardians and delivered at the undermentioned offices not later than Three o'clock in the afternoon on Thursday, January 9th, 1930, endorsed "Tender for Electric Lifts," and the same will be opened at a meeting of the Guardians on that day.
Each person tendering must be prepared to give satisfactory references and sureties, if required.
The Guardians do not bind themselves to accept the lowest or any Tender.
Only Tenders from actual manufacturers of electric lifts with experience in erecting such lifts in public institutions will be considered.
No contract will be given to firms who do not ordinarily observe the recognised rates of wages and hours of labour.
By Order,
ALBERT KING,
Clerk to the Guardians.
Guardians' Offices,
St. John's-road, Upper Holloway, N. 19,
2nd December, 1929. 3877

Manchester Corporation ELECTRICITY DEPARTMENT.
ADVERTISEMENT FOR DRAUGHTSMAN.
DRAUGHTSMAN for large Power Station Layouts. Must have sound experience and training; preference to man having knowledge of Boiler Plant Design. Salary Grade 9 N.J.B. Schedule (present £325 per annum).
Application, stating age, details of training and experience, also copies of testimonials, to be sent to the CHIEF ENGINEER and MANAGER, Manchester Corporation Electricity Department, Dickinson-street, Manchester. 3892

PUBLIC NOTICES

State Electricity Commission OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY and COMPLETE ERECTION of PIPES, VALVES and RECEIVERS with their ACCESSORIES for HIGH-PRESSURE SERVICES at Yallourn Power Station Extensions, in accordance with Specification No. 30/5.
Copies of Tender form, specification, drawings, &c., will be available upon application to the Agent-General for Victoria, Victoria House, The Strand, London, England.
Charge £2 2s. for set of two copies complete, returnable under certain conditions as specified in the general conditions of tendering. Extra copies £1 1s. each, not returnable.
Tenders, on prescribed form, properly endorsed and addressed and accompanied by a preliminary deposit of £50, must be delivered to the undersigned in Melbourne not later than 3rd March, 1930.
The Commission does not bind itself to accept the lowest or any Tender.
W. J. PRICE,
3908 Secretary.

City and County of Kingston-UPON-HULL.
APPOINTMENT OF JUNIOR ENGINEERING ASSISTANT.
The Corporation of Kingston-upon-Hull invite APPLICATIONS for the POSITION of JUNIOR ENGINEERING ASSISTANT with experience in Civil Engineering. Salary £200 per annum.
The person appointed will be required to devote his whole time to the duties of the office, and will be required to contribute to the Corporation's Superannuation Fund, and to pass a medical examination.
Applications, endorsed "Junior Engineering Assistant," and accompanied by copies of three recent testimonials, are to be addressed to the City Engineer, Guildhall, Hull, and delivered not later than Noon on Wednesday, the 18th December.
T. THOMAS,
City Engineer.
City Engineer's Office,
Guildhall, Hull,
7th December, 1929. 3914

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ENGINEER for Work in Spain. Must be able to speak Spanish and have a good practical knowledge of General Mechanical Engineering; age between 30 and 40. Send full particulars with application.—Address, 3888, The Engineer Office. 3888 A

WANTED, CLERK, for Works Manager's Office, Engineering Works in North of England. Must have general knowledge of costing and works routine. Applicants must be over 25 and under 35 years of age. —Address, 3887, The Engineer Office. 3887 A

WANTED Early Next Year, a RESIDENT ENGINEER to Superintend and be responsible under direction for the Construction of a Large Storage Reservoir to be formed by an earthen embankment in the North of England. Member of Institution of Civil Engineers preferred, age 35-50; must have been previously engaged on similar work. Salary £750, increasing by £50 annual increments to £1000. Also an experienced PRACTICAL ENGINEER, competent to Level and Set Out Works as Assistant to above. Salary £350, increasing by £50 increments to £500.—Apply in first instance, before the 15th inst., by letter only, to Messrs. T. and C. HAWKSLEY, of 34, Old Queen-street, Westminster. 3894 A

WANTED, MAINTENANCE ENGINEER in Connection with Large Iron and Steel Works. Candidates' age must not exceed 35 years and must have had an Iron and Steel Works training, experienced in the Installation and Upkeep of all Plant connected with Iron and Steel Works, the organisation and control of men, and sound technical education. Applicants to give full details of their works experience and educational training, copies of references, and also salary required.—Address, 3904, The Engineer Office. 3904 A

WANTED, SECTIONAL ENGINEER for Liverpool-East Lancashire Road Contract.—Apply in writing, giving full particulars of experience (particularly on arterial roads), and salary required, to SIR LINDSAY PARKINSON and CO., Ltd., Ashton-road, Newton-le-Willows, Lancashire. 3874 A

ACCUMULATOR SALES ENGINEER REQUIRED, with technical and commercial experience.—Address, stating experience, age, and salary required, 3880, The Engineer Office. 3880 A

ADVERTISING MAN REQUIRED; Good Copy writer, able to produce layouts with pulling power. Good correspondent with some engineering knowledge. Unique opportunity for right man. State age, experience, salary required.—Address, 3878, The Engineer Office. 3878 A

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SITUATIONS OPEN (continued)

ASSISTANT REQUIRED by Prominent Aircraft Firm, to deal with their Apprentice Training, Works Library, Engineering Society and similar semi-technical duties. Applicant must have secretarial experience and good educational and practical training.—Reply, stating experience and salary required, to WESTLAND AIRCRAFT WORKS, Yeovil. 3889 A

CHARGE ENGINEER REQUIRED, with Experience in Erection and Running of Pulverised Fuel Plants.—Address, P6476, The Engineer Office. P6476 A

CLERK of WORKS WANTED Early in the New Year, to Superintend the Construction of a Jetty of Reinforced Concrete Piling and Superstructure in tidal water on South-East Coast. Applicants must have had good experience in similar works.
Applications, stating age, experience, accompanied by recent testimonials relating to similar works, to be addressed to "Y. D.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 3907 A

ENGINEER REQUIRED, with First-class Manufacturing experience, preferably specialist in Labour-saving and Mechanical Handling Appliances, American or German experience an advantage. State full particulars of experience, age, and salary required. —Address, 3773, The Engineer Office. 3773 A

ESTIMATOR.—A Real Live MAN with Brewery or Chemical experience REQUIRED in S.W. London. Permanent and progressive position to a good man.—Address, P6462, The Engineer Office. P6462 A

INDUSTRIAL ENGINEER.—Age 28-35. Sound technical education, a University Engineering Degree preferred.
Four to five years' practical shop experience essential. Position offers attractive financial future. Post in Great Britain.
Candidates, in replying, should state age, present salary, and general qualifications.
Address, P6457, The Engineer Office. P6457 A

NORTHERN INDIA.—ENGINEER SALESMAN.—A VACANCY OCCURS for Young PUBLIC SCHOOL MAN, age about 25-27, with sound engineering training and of good address.
Salary Rs. 600, rising to Rs. 750 per mensem and bonus. Excellent prospects.
Address, P6459, The Engineer Office. P6459 A

OVERHEAD TRANSMISSION ENGINEER.—CHIEF ENGINEER REQUIRED for the Erection of extensive home contract for Steel Tower Overhead Lines. Definite proof of ability to organise a contract spread over a wide area will be considered as well as transmission line experience.
Written application, stating experience, age, salary required, and when free, to be addressed to FIRELLI-GENERAL CABLE WORKS, Ltd., Southampton. 3878 A

PLANT ENGINEER WANTED by the ALBION MOTOR CAR CO., Ltd., Scotstoun, Glasgow. Applicants should have occupied similar position and have good experience in Modern Factory Maintenance covering Buildings, Machine Tools and Equipment.—Address to WORKS MANAGER, stating age, salary required, and when at liberty. P6466 A

TECHNICALLY TRAINED MAN REQUIRED to Control Aero-engine Inspection Department. Must have had experience in erecting and running Aero-engines. Must be good organiser.—Address, 3900, The Engineer Office. 3900 A

YOUNG ENGINEER REQUIRED for Position as Assistant Engineer, with good technical training, to make himself useful in mainly a technical capacity with a firm of Mechanical Flow Meter Manufacturers. State age and salary expected.—Address, 3906, The Engineer Office. 3906 A

WANTED, a DRAUGHTSMAN for Works Engineer's Department situated in London area. Experienced in Steam Plant, Electrical Layouts, Machinery Designs and Building Work. State age, experience, and salary required.—Address, 3886, The Engineer Office. 3886 A

WANTED, Competent LADY TRACER, to Take Charge of Mechanical Engineers' Tracing Room, Lincolnshire district. State experience, age, and salary required.—Address, 3872, The Engineer Office. 3872 A

WANTED, First-class DRAUGHTSMAN, Experienced in Designing High-class Boiler Mountings, preferably with locomotive experience. State age, experience, and salary required.—Address, 3885, The Engineer Office. 3885 A

WANTED IMMEDIATELY, JUNIOR DRAUGHTSMAN for Detail Work on Machine Tools.—Address, stating age, experience, and salary required, 3879, The Engineer Office. 3879 A

A LARGE MIDLANDS ENGINEERING FIRM WISHES to ENGAGE EXPERT SECTION CONTROL DRAUGHTSMAN. Must possess either specialised knowledge of Agricultural and Industrial Tractors or of Oil-driven Road Rollers. Substantial salaries offered and excellent prospects for right men. Applications for either tractor or road roller business can be considered separately, but preference goes to applicant able to direct both lines. Strictly confidential treatment of all correspondence.—Address, 3901, The Engineer Office. 3901 A

DRAUGHTSMAN DESIGNER, Experienced, WANTED for Commercial Chassis, Midlands. State experience, age, salary required.—Address, P6439, The Engineer Office. P6439 A

DRAUGHTSMAN, First-class Designer, for Machinery similar to Textile and Dyeing. Good opening for suitable man. State age, experience, wages.—Address, 3912, The Engineer Office. 3912 A

DRAUGHTSMEN, First-class Senior Men, Preferably with Aero-engine experience.—Address, stating age, experience, and salary required, 3899, The Engineer Office. 3899 A

DRAUGHTSMAN REQUIRED by Large Engineering Firm in Lancashire, with wide experience of Instrument and Meter Work.—Address, with particulars of age, training, experience, and salary required, 3529, The Engineer Office. 3529 A

DRAUGHTSMAN REQUIRED, Experienced in Heating and Hot Water Supplies, capable preparing schemes and estimates. Full particulars, age and salary required.—Address, P6458, The Engineer Office. P6458 A

DRAUGHTSMAN REQUIRED for Boiler Details. Please give details of experience, &c.—Address, 3851, The Engineer Office. 3851 A

DRAUGHTSMEN REQUIRED; Must Have Had experience in the design of Structural Steel Work. —Apply by letter, THE HORSELEY BRIDGE and ENGINEERING CO., Lionel-street, Birmingham, stating age, experience, and salary required. P6460 A

DRAUGHTSMAN, Structural, REQUIRED for London works. Thorough knowledge of detailing for all classes of Structural Steel Work.—Write, age, experience, and salary required, Box 695 Dorland, 14, Regent-street, S.W. 1. P6469 A

DRAUGHTSMAN WANTED by Manufacturers of Pumping Machinery. Recent experience in design of Centrifugal and Turbine Pumps essential.—Address, stating age, experience, and salary required, 3910, The Engineer Office. 3910 A

HENRY BERRY and COMPANY, Ltd., Croydon Works, Leeds, have VACANCY for JUNIOR DRAUGHTSMAN, with experience in design of Hydraulic Machine Tools. Apply, giving full particulars of technical education, experience, age, and salary required. 3905 A

SITUATIONS OPEN (continued)

SENIOR and JUNIOR DRAUGHTSMEN REQUIRED, with experience of Automatic Packing Machines for design work in North London district. Practical experience of assembling and testing this class of machinery, together with knowledge of engineering manufacturing will be accepted in place of long drawing-office training.—Address, stating age, fullest details of experience and salary required, 3913, The Engineer Office. 3913 A

THE CHATWOOD SAFE CO., Ltd., Bankers' Engineers, Shrewsbury, are obliged to increase their drawing-office staff and invite APPLICATIONS from capable JUNIOR and SENIOR DRAUGHTSMEN with sound mechanical training.
Particulars of experience, age, and salary required, together with small sample of candidate's work, should be addressed to the TECHNICAL DIRECTOR. 3875 A

THREE SMART MECHANICAL DRAUGHTSMEN REQUIRED in S.W. London, with Brewing, Chemical or Dairy experience an advantage. A permanent position is offered to quick and accurate men, age 26 to 32.—Address, P6461, The Engineer Office. P6461 A

WANTED, FOREMAN for Small Foundry and Engineering Works in East Anglia (country district) manufacturing Motor Boat and Marine Motor Fittings; energetic young man with experience of up-to-date Machine Shop Methods. Good prospects for man who can organise for output. Drawing-office and Motor Boating experience useful.—Address, 3903, The Engineer Office. 3903 A

FOREMAN PLATER REQUIRED, to Control Manufacture of Boiler Plate Work, Tanks, Pressure Vessels, &c. Man with first-class experience required. State age, wages required, experience, and when at liberty. Mark envelope "Foreman."—ROBERT JENKINS and CO., Limited, Rotherham. 3896 A

FOREMAN WANTED, with Experience of Mass Production on the assembly of Radio Valves. Must have had experience of processing and planning, and also knowledge of the design and use of the tools and fixtures required to obtain lowest costs.—Address full particulars, including age, experience, and salary required, 3917, The Engineer Office. 3917 A

DIESEL ENGINE DRIVER WANTED for London district. Experience with Ruston Engines and D.C. Generator and Switchboard Operation an advantage. State age, experience, and wages required.—Address, P6464, The Engineer Office. P6464 A

FITTER, Age 27-35, with Technical Experience, REQUIRED for London factory; used to Rubber or similar Plant. State experience, &c.—Address, P6475, The Engineer Office. P6475 A

SITUATIONS WANTED

ADVERTISER, with Experience as Buyer, Cashier, office manager, costs, shipping, general engineering, SEEKS EMPLOYMENT, any capacity.—Address, P6474, The Engineer Office. P6474 B

A.M.I.C.E., A.M.I. Mech. E. (39), Railway Locomotive works, D.O., running shed, motor, tramway and general mechanical experience, also public works and commercial experience, long and successful experience control of large staffs, DESIRES CHANGE.
Address, P6472, The Engineer Office. P6472 B

CHARTERED CIVIL ENGINEER (30, Married), long experience (as resident engineer and contractors' engineer) of public works, reinforced concrete, cement works, &c., will shortly be OPEN for ENGAGEMENT. Would represent firm of standing. Details and references at interview to be arranged. Address, P6468, The Engineer Office. P6468 B

CLERK.—Middle-age MAN REQUIRES SITUATION, London. Shorthand, typewriting, filing, telephone. Many years engineers' office.—Address, P6473, The Engineer Office. P6473 B

DESIGNER, 20 Years' Experience with Well-known firms in development and production of general engineering and instrumental work, SEEKS RESPONSIBLE POST.
Address, P6477, The Engineer Office. P6477 B

ENGINEER, A.M.I. Mech. E. (42), SEEKS POSITION, home or abroad; 11 years' experience abroad erecting and maintaining plants. Good control of labour. At present free.—Address, P6470, The Engineer Office. P6470 B

ENGINEER, Practical and Commercial, DESIRES POST as Manager or responsible position. Wide experience management general engineering and foundry. Excellent references.—Address, P6333, The Engineer Office P6333 B

EXPERIENCED ENGINEER, at Present Chief Engr, industrial concern, salary £750, WISHES POSITION as MANAGER. Age 42. Unimpeachable record.—Address, P6421, The Engineer Office. P6421 B

FOUNDRY MANAGER, 14 Years' Practical Experience in loam, green and dry sand, and 14 years of management, SEEKS SIMILAR POSITION. At liberty Dec. 21st.—Address, P6480, The Engineer Office. P6480 B

GENERAL MANAGER, to Take Complete Control of Executive Staff. Wide experience of engineering production and new materials and methods. Expert designer.
Has built special production machines and perfected methods which have saved hundreds of pounds.
Extensive knowledge of markets gained from travel and sales experience abroad.
All negotiations treated in the strictest confidence.
Write, Box F. 71, Willing Service, 86, Strand, W.C. 2. 3553 B

MECHANICAL ENGINEER, Age 41, Experienced, WANTS POSITION of RESPONSIBILITY in an established business. Would provide capital if required.—Apply, PRITCHARD and SONS, 2/4, Billiter-avenue, London, E.C. 3. P6483 B

MECHANICAL ENGINEER and DESIGNER (First-class Diploma) DESIRES APPOINTMENT. Exceptionally broad experience, has initiative, skill and capacity for detail; efficient draughtsman, fluent French. Excellent record.—Address, L. M., 24, St. Mark's-road, North Kensington, W. 10. P6482 B

MECHANICAL ENGINEER, Age 41, Experienced, WANTS POSITION of RESPONSIBILITY in an established business. Would provide capital if required.—Apply, PRITCHARD and SONS, 2/4, Billiter-avenue, London, E.C. 3. 3868 B

MECH ENGINEER, Public School, Age 40, URGENTLY REQUIRES POST. Thorough experience of works management and commercial side of engineering. Accept position in works or sales engineer. London area preferred.—Write, Box Z, 182, Willings 86, Strand, W.C. 2. 3757 B

WORKS MANAGER, Plant Engineer (32), SEEKS APPOINTMENT; experience on locomotive, wagon, lorry bodies, laminated spring manufacturing. Disciplinarian. Excellent record.—Address, P6481, The Engineer Office. P6481 B

CENTRAL HEATING.—SITUATION WANTED as Working or Supervising Foreman, thoroughly practical and experienced in all branches of the heating trade; many years supervising foreman with London heating engineers. Good references.—R. H. WENT, 23, Hazellville-road, London, N. 19. P6463 B

PARTNERSHIPS

CONSTRUCTIONAL ENGINEERS, London, Would consider JUNIOR PARTNER; £1000 min. Technical and practical. Good scope.—Address, P6484, The Engineer Office. P6484 C

AGENCIES

A. I. MECH. E., M.I. LOCO. E., OPEN ACCEPT AGENCY for home and export markets where unique connections, technical and commercial qualifications and selling organisation could be applied to advantage. Offices and storerooms, Westminster.—Address, 3748, The Engineer Office. 3748 D

ENGINEERING FIRMS WANTED.—London PUMP MANUFACTURERS REQUIRE First-class Firms as SOLE AGENTS in industrial areas, Rotary and centrifugal.—HUTCHINS and HARRIS, Ltd., Advertising Agents, Windsor House, Victoria-street, S.W. 1. 3876 D

SALES ENGINEER, M.I. Mech E., OFFERS Firms Requiring London Representation the advantage of PERSONAL ATTENTION and an ESTABLISHED CONNECTION among steam users in London and district. Office Central London. Substantial contracts in hand. Commission and nominal amount for part expenses.—Address, P6442, The Engineer Office. P6442 D

EDUCATIONAL

Correspondence Courses
OF PREPARATION FOR THE
Examinations of the
INST. OF CIVIL ENGINEERS,
INST. OF MECHANICAL ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.
are personally conducted by
Mr. Trevor W. Phillips,
B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.
For full particulars and advice apply to:—36, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE: 65, CHANCERY-LANE, W.C. 2. Ex.

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For continuation of For Sale Advertisements see page 98.

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See last week's advertisement page 60.

A Seven-Day Journal

New Tube Railways and Suburban Electrification.

ON Monday the Minister of Transport, Mr. Herbert Morrison, received a deputation consisting of Members of Parliament for the North London constituencies and representatives of the North London Travelling Facilities Committee. The object of the deputation was to make representations to the Minister concerning improved travelling facilities in the North Middlesex area. The deputation's remarks centred round two aspects of the question, the extension of the tube railway northwards from Finsbury Park and the electrification of the suburban lines from King's Cross and Liverpool-street stations. Mr. Morrison informed the deputation that the London Electric Railway Company had definitely decided to seek powers in the present session of Parliament to extend the tube railway from Finsbury Park through Wood Green and East Barnet to Cockfosters. Regarding the electrification of the London and North-Eastern Railway Company's suburban services, he said that he had urged upon the company the desirability of undertaking the work, and that he was definitely more hopeful that in the near future the company would find it possible to electrify part of the suburban lines from King's Cross. He was informed, however, by the company that there were special difficulties in the way of electrifying the suburban lines from Liverpool-street. He added that the question of extending the Central London Tube Railway from Liverpool-street northwards through Tottenham and Edmonton to Enfield could not properly be dealt with until a decision had been reached regarding the electrification of the Liverpool-street suburban lines.

London Traffic Services and Public Ownership.

ON Monday an important announcement was made in the House of Commons by the Minister of Transport concerning the Government's proposals for the improvement of London traffic services. The Government, Mr. Morrison said, was in agreement with the opinion expressed by the London and Home Counties Traffic Advisory Committee that no lasting solution of the dual problem of the congestion of the streets and the provision of proper facilities for the travelling public would be found unless further steps were taken for the elimination of uneconomic and unnecessary competition. It also agreed with the Committee that a far-reaching measure of unification under public control was essential to progress. It had therefore come to the conclusion that the ends in view could be fully achieved only if the existing sectional financial interests were consolidated by the substitution of a single and simple form of public ownership for the complicated network of separate interests, private and municipal, which now added so greatly to the difficulties of the situation. It was therefore intended to proceed at once with the exploration of a plan for the complete consolidation, upon fair and equitable terms, of the passenger transport agencies now providing services by omnibus, tramway, or local railway in the London traffic area. While the principle of public ownership would be applied, it was intended that the consolidated system should be commercially managed and self-supporting, and that its earnings should be sufficient to meet all proper charges, including reasonble remuneration of capital, and to attract fresh capital for development purposes. The relations to be established between the consolidated undertaking and the main line railways merited, and would receive, careful consideration. The intricacy of the subject was such, Mr. Morrison added, that no further statement on it could be expected for some time. The magnitude of the consolidated undertaking contemplated is shown by the fact that the various interests concerned have an aggregate capital at present of £124,000,000, and that during 1927 they were responsible for the transport of over 2622 million people.

The New Director of Naval Construction.

CONSIDERABLE satisfaction will be felt by the members of the Royal Corps of Naval Constructors in the selection of Mr. A. W. Johns, Deputy Director of Naval Construction, to succeed the present Director, Sir William J. Berry, who will retire on January 23rd, 1930. On several occasions in the past the post of Director of Naval Construction has been filled by the appointment of a naval architect from one of the private naval construction yards, but Mr. Johns has the distinction of having risen in Admiralty service to the highest position in his profession. He entered Devonport Dockyard in 1887 as a shipwright apprentice, and in 1891 gained a scholarship to the Royal Naval Engineering College at Keyham, passing in 1892 to the Royal Naval College at Greenwich, where he studied for three years. He returned to Greenwich in 1898 as instructor in naval architecture, and some three years later he was appointed to the staff of the Constructive Department at the Admiralty. During his period of service he was engaged on the designs of the "King Edward VII." class of battleship, and from 1910 to 1912 he was the principal overseer at the Thames Ironworks at Blackwall, during the construction of the last Thames-built battleship, H.M.S. "Thunderer." On the completion of that ship he was entrusted with the designing of British submarines, and he continued these duties throughout the war period. Mr. Johns was also engaged for a time on the design and construction of rigid airships, while in recent years he has had charge of the designs of flotilla leaders, destroyers, cruisers, and aircraft carriers. He has also served as the Chairman of the Joint Technical Committee on Aviation Arrangements in Naval Ships. Mr. Johns has contributed many valuable papers to the "Proceedings" of the Institution of Naval Architects, and is a member of the Council of that Institution. He has also contributed several interesting articles to our own columns, and we wish him every success in the new and high position in which his long and varied experience will find increased use.

Power Station Fumes Appeal.

WITH modifications of the judgment of the Court of Appeal, the House of Lords dismissed on November 28th the appeal of the Lord Mayor and Corporation of Manchester, which arose out of a claim by Mr. Arthur Farnworth for damages and for an injunction to restrain the Corporation from committing a nuisance at its electrical power station at Barton-upon-Irwell. Mr. Farnworth complained that the fumes, gases and noxious matter emitted from the station spread over his farm land and buildings, but the Corporation contended that by virtue of the Manchester Corporation Act, 1914, it was entitled to use the generating station, even if it could not do so without creating a nuisance. In effect the Corporation argued that the Barton station was an "authorised nuisance." Mr. Justice Talbot, in the first instance, decided for the Corporation, but the Court of Appeal reversed his judgment on the ground that the Corporation had not proved that it had operated the generating station without negligence. During the hearing in the House of Lords, Viscount Dunedin emphasised the gravity of the nuisance caused by the pollution of the air, and said that it naturally made one reflect on the magnitude of the nuisance that would be caused by stations far bigger than the one under consideration. Had the Corporation been under a nuisance clause it would have exerted itself to find a remedy. Viscount Sumner said that the ordinary South Lancashire coal contained some 2·2 per cent. of sulphur, and that was the coal which the Corporation used. Coal was to be obtained, however, which was practically free from sulphur, but to use such coal would certainly be costly, and it would perhaps be difficult to obtain enough of it. It was hard to show that no remedy for the nuisance could be found. The appeal was dismissed, the order of the Court of Appeal being varied slightly as to the damages to be recoverable.

The Retirement of Mr. R. Woodward.

THE retirement is announced of Mr. Robert Woodward, one of the founders of Edgar Allen and Co., Ltd., of Sheffield, and the chairman of the company since 1915. Mr. Woodward, who is eighty-six years of age, joined the Stockton and Darlington Railway as a telegraph clerk in 1857, and for some years interested himself in journalistic work. In 1866 he became the secretary of the Titanic Iron and Steel Company in the Forest of Dean, and came into close touch with Mr. Robert F. Mushet, the inventor of self-hardening tool steel. Five years later Mr. Woodward joined Samuel Osborn and Co., of Sheffield, and he continued his connection with that firm until he joined Mr. Edgar Allen in partnership in 1890. The business of Edgar Allen and Co. continued to develop, and Mr. Woodward devoted his special attention to the overseas department of the firm, which has continued to expand. Mr. Woodward, who will now live in Bournemouth, is to be succeeded by Mr. C. K. Everitt, who has been associated with the firm since 1881, mainly in connection with the steel works department. It was largely due to Mr. Everitt that the Heroult electric arc type of furnace was introduced into this country, and he also worked on the first Tropenas converter plant, which was installed some years ago in Edgar Allen's works. Mr. Everitt is the President of the Steel-melting Section of the Sheffield Trades Technical Society, and was the first President of the Sheffield and District Engineering and Steel Trades Council.

The Preservation of Timber.

AT a meeting held in London on Tuesday, a British Wood Preservers' Association was formed. The meeting was largely attended, among those present being representatives of Government Departments, the railway companies, estate owners, engineers, architects, chemical manufacturers, and others. The movement for the formation of the association was begun by the Association of Tar Distillers. Sir Harold Boulton, addressing the meeting, said that the objects of the new Association would include the spreading of knowledge concerning the practice of wood preservation, the standardisation of wood preservatives and the methods of their application, the investigation of wood preservation methods, and the interchange of ideas and of information concerning wood preservation practice between the members. Incidentally, he stated that a method had been found for treating Douglas fir in order to make it suitable for use in railway sleepers in place of Baltic timber. Sir James Calder mentioned that there was likely soon to be a shortage of soft woods, and therefore that it was necessary to find some method of prolonging the life of such timbers and of conserving our resources, so as to reduce importation. Lord Clinton, lately Chairman of the Forestry Commission, stated that support for the Association had been promised by the railways, the British Engineering Standards Association, and the Forest Products Research Station. An important subject for the Association's study would be the discovery of means whereby the resistance of certain timbers to impregnation could be overcome. The loss of strength which many timbers suffered as a result of treatment would also engage its attention. Sir George Courthope, speaking for the Forestry Commission, welcomed the formation of the Association, and drew attention to the fact that imported timber had at present readier access to preserving plants than home-grown timber, to the disadvantage, naturally, of the latter.

A New System of Wireless Reception.

THE results of Dr. James Robinson's new system of radio reception demonstrated a few days ago have created a considerable amount of interest. One of the outstanding claims for the system is that it would enable 5000 stations to broadcast on wave lengths between 300 m. and 600 m., instead of about twenty-five as at present. Whereas listeners can now tune stations in and out by moving one degree on the condenser dials of their sets, the new system, it is claimed, can separate stations to one-hundredth of a dial degree. In a test recently carried out an oscillator using sufficient power to transmit on short waves to America was set to work on a receiving aerial. Loud shrieks issued from a loud speaker and almost drowned the 2LO programme. The oscillator was tuned to a frequency within 100 cycles of London, but on a set fitted with Dr. Robinson's invention the London programme was freed from the oscillator and the oscillator, in turn, freed from London. The system is claimed to offer wireless authorities all over the world a way out of the present difficulties of congestion of the ether. Dr. Robinson mentioned at the time of the demonstration that one of the difficulties associated with television broadcasting was that it required a space in the ether equal to about ten ordinary broadcasting stations, but under the new system that difficulty would be removed.

Salvage Operations at Scapa Flow.

ON Friday of last week, November 27th, the upturned hull of the 4000-ton ex-German light cruiser "Bremse" was safely brought alongside the Lyness Pier depôt of Cox and Danks, Ltd. The ship was towed a distance of 10 miles from the site at which she was raised, which is one of the most exposed positions in the Flow. Actually, the vessel was floated upside-down on practically an even keel some months ago, but during a storm the buoyancy was lost and the ship heeled over on her side, necessitating the provision of new air locks and a recommencement of the salvage operations by means of compressed air. These operations have been continually interrupted by heavy weather, and it was only on Wednesday, November 25th, that the hull was refloated with a small list of 7 deg. to 8 deg. The "Bremse" is the first of the light cruisers to be raised, and she is the twenty-ninth ship to be salved by Cox and Danks, Ltd. Preparatory work is now to be begun on the "Hindenburg" and the "Von Der Tann," which will form the main programme of next year's operations. Meanwhile, several of the gun turrets which have been cut away from the cruisers already raised are being recovered. It is with great regret that we record the death of one of the salvage engineers of Cox and Danks, Ltd., Mr. M. Carmichael, who was in charge of the salvage operations on the White Star liner "Celtic" at Queenstown. Mr. Carmichael succumbed to gas when going to the rescue of two workmen in one of the holds.

Billingham Synthetic Nitrogen Works.

FROM information given in the report of Synthetic Ammonia and Nitrates, Ltd., of Billingham-on-Tees, it would appear that the programme of constructional work is now almost completed. The No. 5 unit of the nitrogen fixation plant is now in operation, and the production of ammonia sulphate has been increased to about 2000 tons per day. The Billingham factory may now be classed as one of the largest nitrogen fixation plants in the world. The construction of these works has given employment to many men, and large contracts have been carried out by British firms. An effort is now being made to absorb a number of the staff and the men who have been so far engaged on constructional work into process work, and this will continue for some time to come. A new alkali works is being built on the south side of the Billingham factory, and when this is completed it will replace the older factories at Wallsend-on-Tyne, at Maryhill, and other places. The number of workmen's houses which are now owned by the company is over 1800.

The Shipyard and Engine Works of J. Samuel White & Co., Ltd., at Cowes, I.O.W.

No. II. (*Conclusion*)*

THE ENGINE WORKS.

As will be seen from the accompanying plan—Fig. 11—the lay-out of the machine shops is such that there is one long heavy machinery bay, known as "E" machine shop, from which "A," "C" and "D" machine shops, the tool-room, the condenser and marine engine erecting shops, and the fitting shop all run at right angles and to westward. The two bays of the boiler shop, the main power-house and the turbine testing and erecting shop all run eastward towards the water side. There is a railway track to the quay side, so that the heavy castings and forgings can be easily transported into the large machine shop where the general process of manufacture begins.

The main bay, a view of which is shown in to-day's Supplement, is about 100 yards long, and is provided with two cranes, one of 30 tons and one of 12 tons, both by Babcock and Wilcox, Ltd. In this shop there are placed all the heavy boring machines which are used for boring the turbine casings, and sometimes to carry out work on the drums of water-tube boilers when plate thinning has to be done circumferentially. The same machines are used for boring out reciprocating engine bed-plate bearings, and for any work which cannot be easily accommodated in other boring machines. They are capable of handling work up to 12ft. diameter and 30ft. long, and were all made by Shanks. Vertical boring mills also occupy a very prominent place in this shop. They range from a Hetherington mill with a 24ft. diameter table to a Richards machine with a 5ft. table. We noticed five Richards machines with face plates of different diameters up to 9ft. These machines are employed, we were informed, for many operations, including some which are more often performed in the lathe. This work includes the turning of turbine discs, the boring out of reciprocating engine cylinders, the machining of large stop and throttle valves, the turning and finishing of propeller cones, liners and bushes, &c., and, indeed, any job which can be suitably fixed to the table. Ease of chucking is a particular feature of vertical boring mills, and the crane is free almost immediately it has deposited the article on the face plate.

In this shop we also saw two large centre lathes for turning turbine rotors, one of which has a face plate 10ft. diameter, and will accommodate a length of 24ft. between its centres. The other has a face plate of 8ft. diameter, and a bed which will take 20ft. between centres. These lathes are principally used for turning, grooving and blade tipping of rotors, and occasionally for machining reciprocating engine crank shafts. Other items of the equipment include two horizontal drilling and milling machines by Campbells and Hunter, and a radial drilling machine by the same makers, all arranged for heavy duty work; a large radial drilling machine by Asquith, and a Richards planing machine with a travelling head designed to plane 24ft. by 10ft. These tools are employed for the machining of turbine casing joints, the planing of reciprocating engine bed-plates, the machining of water-tube boiler drums and numerous other duties, both for the engine works and the shipyard. The last-named machine is fitted with a Vickers drive, which gives a speed variation of 3 to 1 between the cutting and the return strokes, with a serviceable number of graduated cutting speeds. A side-arm Richards planer fitted with a Lancashire drive also finds work in this shop.

Shop "A" contains the smaller machines, and when laid out in 1911 represented advanced ideas in marine engine manufacture, in that a large number of semi-automatic machines were installed to take the place of the old-time centre lathe. In all, there are, in this shop, some thirty machines specially designed for producing repetition work from either bar or castings. Many of the twenty other lathes are purely chuck machines, which are capable of being arranged for special jobs on repetition lines. There is also a broaching machine which is used in connection with the production of heavy oil engines which the firm manufactures. In this particular bay there are twelve drilling machines, all of which are engaged on the production of standardised parts. Among these parts, we noted filters for oil-fuel equipment, and three-throw hand oil-fuel pumps which are made in large quantities for the Navy. Among other tools in this department are vertical boring mills, shapers and slotters, grinding machines, milling machines and profiling machines.

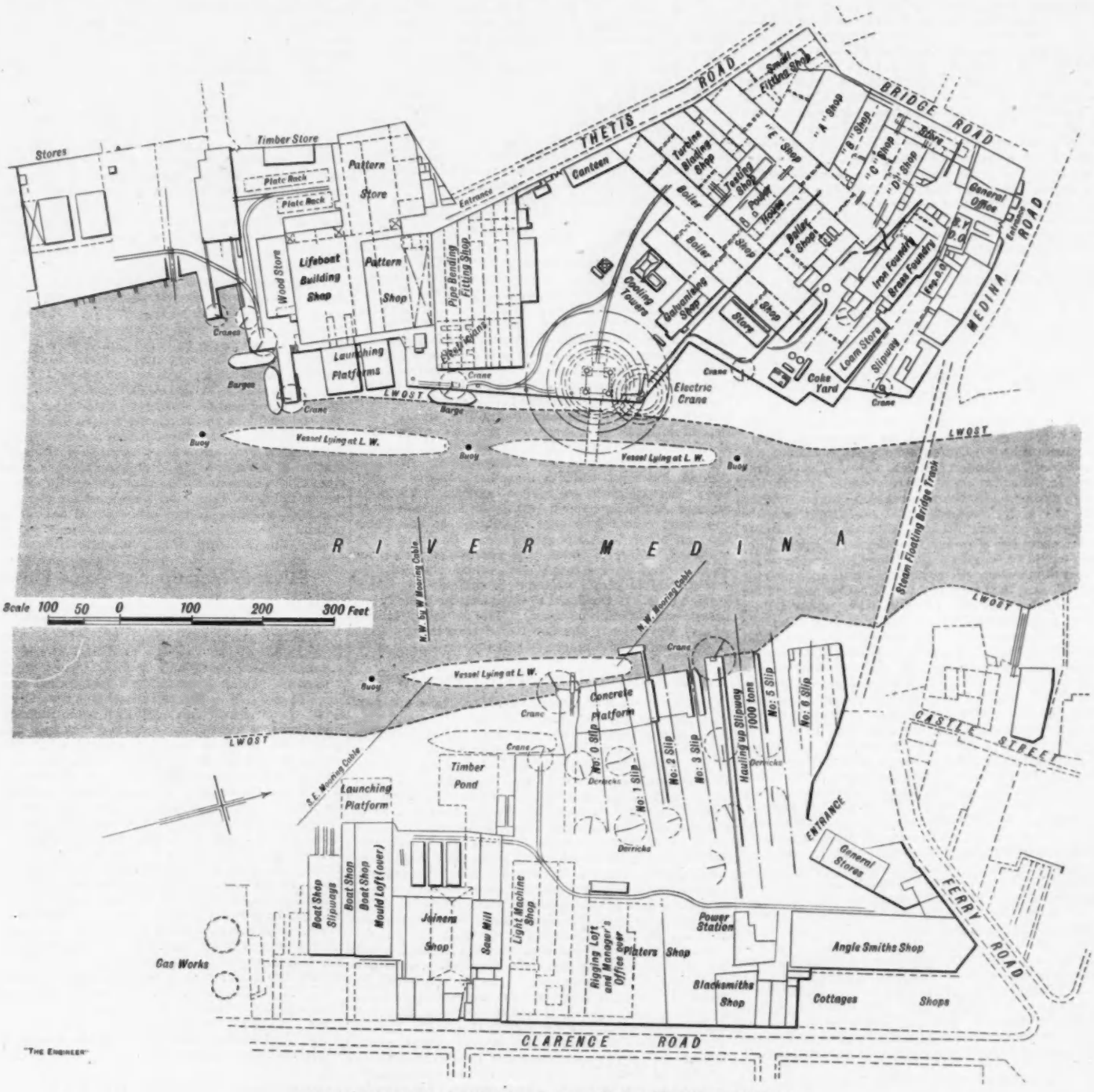


FIG. 11—PLAN OF THE SHIPYARD AND ENGINE WORKS AT COWES

THE TOOL ROOM AND GAUGING SYSTEM.

The tool room, which is adjacent to "A" shop, we found to be well equipped with the usual precision lathes, milling machines, plane and surface grinders and hardening furnaces. In this department there is a 50-ton Buckton testing machine, and a smaller

* No. I. appeared November 29th.

one by Avery. A Brinell hardness tester and scleroscope equipment forms a part of the testing plant which is used for proving the incoming material. A complete gauging system on the Newall standard is in use throughout the engine shops, and everything is manufactured to fine limits. There is a 4ft. Newall measuring machine with a full set of reference gauges, which forms the standard base to which all the shop gauges are referred.

TURNING TAIL SHAFTS AND OTHER OPERATIONS.

In "C" machine shop we noted a large Churchill plain grinding machine with a capacity for work up to 12ft. long by 30in. diameter. There are also

FIG. 12—TURBINE BLADING AND ROTOR TESTING SHOP

two planers by Redman, one 12ft. by 4ft. 9in., and one 8ft. by 3ft. 9in., both being equipped with a Lancashire drive; a large slotter by Holroyd having a stroke of 22in., as well as two of smaller size; two horizontal boring, facing and milling machines, one a No. 3 Richards, the other a No. 4 Kearns, and a large plano-milling machine by Muir, as well as two radial drilling machines by Archdale. Several smaller slotting and shaping machines permit a variety of operations to be carried out in this section of the works.

Most of the centre-lathe work is handled in "D" shop, a view of which is reproduced in Fig. 13. A Loudon shafting lathe, with a bed 70ft. long by 15in. centres for the machining of long tail shafts, is worthy of particular attention. This lathe, we noted, while arranged for screw cutting, is somewhat different from the usual screw-cutting pattern, inasmuch as two short lead screws are fitted, one under each saddle apron. The nut is stationary, but, by securing it to the front side of the bed on a tee-slotted facing, which extends the whole length of the lathe, it is possible to adjust the screw position to suit the position of the screw thread to be cut. The lead screw is driven through gears from a plain shaft which extends the full length of the bed, and it works in the nut up to the limits imposed by its length. As most of the shafting work calls for relatively short screw threads the 2ft. 6in. which this lathe can screw is more than ample for the requirements likely to be met. In this shop we also saw a number of other lathes of standard design which are used for work of a general character.

TURBINE AND CONDENSER TESTING PLANT.

The fitting up of details such as valves, ball joints, thrusts, small pumps, and oil firing gear, is carried out in a special machine shop, which, besides having the usual facilities for water testing, is provided with a "White-Forster" 300 lb. water-tube boiler for testing various parts under steam. The erection of reciprocating engines and large condensers for turbine installations is carried out in the main shop, but erecting and testing of turbine and gearing is allocated to the testing shop, a view of which is given in the Supplement. This illustrates a 22,500 S.H.P. geared turbine unit for one of the recently completed Argentine flotilla leaders. Close to this shop is a large "White-Forster" boiler of 4100ft. heating surface, fitted in a closed stokehold, and capable of giving 40,000 lb. of steam per hour. The steam from this boiler is used in conjunction with a Mirrlees Watson jet condensing plant for testing turbines for vibration, both at their normal and at overspeed revolutions.

THE DYNAMIC BALANCING OF ROTORS.

Closely associated with the turbine steaming testing machine in order to verify dynamic balance is the special machine used by Messrs. Whites to determine the magnitude and direction of the unbalanced dynamic forces in the finished rotors before they are put into their respective cylinders for steam trial. The actual apparatus, which is illustrated in Fig. 12, was designed by William Muir and Co., Ltd., of Manchester, and is designed to take rotors or any circular body having a weight up to 12 tons, and a diameter up to 6ft. In the machine, the part to be balanced is supported in two bearings which are held in spherical housings, and is thereby permitted a limited movement relative to the housing. These bearings are attached to their supports by vertical spring reeds, which are bolted in a vice-like jaw, both on the bearing housing and main head or support. This particular form of fastening permits the bearing to make an oscillatory movement in a horizontal plane at right angles to the axis of the journal, but when it is desired to lock the bearings to prevent such movement, it can be done by screwing out two stops carried inside horns of the heads which are arranged in line with the centre of the bearing.

The journal of the body to be balanced is furnished with a coupling disc, which is the counterpart of that carried on the driving motor extension shaft, and, together, these parts form an electro-magnetic clutch, which, when the system has reached the desired rate of rotation, can be instantly freed, leaving the unbalanced body rotating on the two machine journals which have been previously locked against movement by the stops already described. When the clutch is quite free, and while the body still rotates at a speed in excess of the critical speed of the system—in the machine in question it is never more than 750 revolutions per minute, and, generally, in the region of 400–500 revolutions per minute—one bearing is set free to oscillate under the influence of the out-of-balance forces. This force, as it passes the centre line, exerts a deflecting tendency on the spring which supports the bearing, and this is repeated twice in each revolution. The spring support has, however, its own natural rate of vibration, and when the impulses from the disturbing force are delivered at a frequency which coincides with the natural period of the spring, the vibrations of the spring become very marked. This state is, of course, reached and passed through as the revolutions of the rotating body continue to diminish after being disconnected from the motor, and the vibrations of the bearing gradually increase in amplitude until they attain a maximum at the instant when the revolutions of the unbalanced body are equal to one-half of the natural period of the spring system which carries the journal. By observing this, the dynamic balance may be detected, but to be able to correct the fault, it is necessary also to know both the magnitude and direction of the disturbing force. The magnitude of the force bears some relation to the amplitude of the spring vibration and its direction is obtained by marking the shaft during the vibration period in order to determine which part of the shaft is on the horizontal centre at the moment of maximum lateral disturbances. This is done by means of a metal comb with five teeth, in which the teeth are so held as to be free to be pushed back by the application of pressure, but, at the same time, gripped sufficiently hard to enable them to mark the shaft. The comb is held horizontally in a special carrier, and the carrier is so adjusted in a horizontal direction as to be at a slight angle to the shaft. In such a position the first tooth is permitted just to touch the shaft, but the second and subsequent teeth are furnished with clearances between their tips and the shaft, the amount of which progresses from tooth to tooth. As the shaft rotates, the first tooth makes a circle, but not until the shaft oscillates do the second and the other teeth come into operation, and then only as the amplitude of the vibration increases. In consequence, the shaft becomes marked with a series of lines of varying length, all of which, except the first finish in the same circumferential plane, showing the line of maximum horizontal disturbance. Were the line of action of the disturbing force, and the movement of the disturbed body to be in step, then the plane of unbalance would be indicated by the line actually marked by the comb, but as there is a time lag between the impression of the force and the response of the impressed body, it is necessary to record the markings again with the direction of rotation reversed. That being done, the line of action of the disturbing force can then be taken as lying about midway between the indicated planes of maximum disturbance. The balance weight to be added is then required on the side on which the teeth of the comb have made no marks. A means is also provided for recording the magnitude of the oscillation on a chart, the actual movement being magnified for that purpose. As to the exact value of the weight to be added, no satisfactory and ready calculation can, we understand, be made, but trial and error taken in conjunction with the two indications, which have been referred to above, are capable of yielding excellent practical results.

After nearly approaching the desired state of balance at one end of the body, the other end, which up to then has always remained locked against oscillation, is similarly dealt with, while the balanced end is secured, and, when both are balanced, the whole unit is tested by freeing both bearings simultaneously. It is sometimes necessary to return to the first end, after completing the second, to make further adjustments, but very rarely is it found to be necessary to give additional attention to the second end. It has been found possible with this machine to balance a rotor weighing 4 tons in 1½ hours, and with a standard of perfection which by other methods has hitherto been unattainable. The condition of initial unbalance in the instance we have cited was represented by a

FIG. 13—PROPELLER SHAFTING IN THE TURNING SHOP

pencil indication of the oscillations measuring 2in. in length, and when finally set in motion after being balanced was barely $^1/_{32}$in. in length. In both cases a magnification of six times the actual length was used.

The Boilermaking Plant.

The boiler shop is laid out specially for the production of water-tube boilers of the "White Forster" and the straight-tube pattern. The tube plates of the steam drums and the water pockets are dealt with by a large oil-fired heating furnace, close to which is arranged a set of rolls for giving the requisite curvature to the plates. The maximum width which the rolls can take is 16ft. and plates up to 2in. thick and of that width can be handled. Two views of this shop are reproduced in the Supplement.

Close to the furnace there are two flanging presses which are used for pressing the dished ends for steam and water drums and for the usual flanging work on Scotch boiler fronts, backs and combustion chamber plates, which, although the department is not specially suited for the production of this type of steam generating plant, nevertheless finds a place in the list of the firm's different manufactures. The drilling of tube plates for water-tube boilers is done on a series of four-spindled machines by Noble and Lund, Ltd. These machines are equipped with jigs and fixtures necessary for the easy and accurate setting and execution of the work. The drill heads, we noted, may be set either vertically as for the straight-tube type drilling, or inclined at an angle to the axis of the drum when drilling "White-Forster" boilers. There are in all six machines of this type, two being rather larger. The latter are intended for the steam drum work, while the water pocket plates are drilled on the smaller machines.

Rivet holes are drilled on the usual type of shell drilling machines, which is also used for tapping the tube and stay holes of cylindrical boilers. It is a single-headed machine and was built by Campbells, Hunter and Co., Ltd.

The combustion chamber rivet and stay holes are drilled on a horizontal machine fitted with a rotating and traversing table, which gives the compound motions necessary for satisfactory setting of the work to the drill. For shell and other riveting two hydraulic riveters are installed, one having a gap of 12ft. and the other 6ft. They are supplied with pressure water at 1500 lb. per square inch from a large accumulator served by a three-throw electrically driven pumping set, by Fielding and Platt, Ltd., while two air compressors of 50 and 75 H.P. respectively provide the compressed air for the shop services.

All the light plate work for the casings, uptakes and funnels is done in a small bay running parallel to the main shop, and in this shop there are several medium-sized punching and shearing machines, levelling blocks, drilling machines, and light rolls.

The preparation of the tubes for water-tube boilers occupies an important part in the routine of the boiler shop, and a separate section of this department is set aside for the cleaning, electro-galvanising and inspection. The tubes are tested hydraulically and then mechanically by expanding and belling the ends, and, after liming and plugging, the accepted tubes are stored in racks until needed. A special roll is provided for giving the curvature to the tubes for "White-Forster" boilers, which, as is generally known, has the whole of its tubes curved to a uniform radius to facilitate their withdrawal into the top drum for purposes of renewal. The boiler shop, as all other departments, is well served with large overhead travelling cranes.

Some Other Departments.

Any description of the West Cowes works would be incomplete without reference to the well-equipped iron and non-ferrous metal foundries with their sand preparing and fettling shops, which produce all but the largest castings required by the engine works and the shipyard. In another part of the works is a well-equipped patternmaking shop and an extensive pattern store. As the drawing Fig. 11 shows, all the principal departments are interconnected by a rail track, along which a travelling crane operates, to facilitate the transport of material into the yard and works and on the fitting-out quay. Two other departments which are closely associated with the work of completing the vessels under construction are the pipe bending and fitting shop shown in Fig. 14 herewith, and the electricians' department, in which ship work as well as repairs to the works electrical plant is carried out. Some further particulars of these shops are given below.

Fitting Out Facilities.

As will be seen from the views reproduced in the Supplement, an excellent fitting-out quay is provided at West Cowes. It is well served by an 80-ton Babcock and Wilcox hammer-head crane, which has a lifting capacity of 80 tons at a 42ft. 6in. radius, and 40 tons at 72ft. 6in. radius. Alongside it there is a 30-ton, 24ft. radius electric crane, while additional lifting power is provided by a travelling steam crane.

The fitting-on-board department is accommodated in the buildings at the south end of West Cowes Yard and quite within easy reach of the quayside, where vessels lie whilst receiving their machinery. They are brought within the crane radius from the engine and boiler shops on bogies of specially low construction, and a railway line is run from the boiler shop for this purpose. To facilitate the work involved in installing the machinery, a few handy machine tools are provided for the use of this department, whilst the coppersmiths, iron pipe benders, laggers, and the electrical departments are housed under the same roof. One machine of special note is the hydraulic pipe bending machine, by Hugh Smith and Co., Ltd., of Possil Park, Glasgow, which was described in THE ENGINEER of November 13th, 1923, and is shown in Fig. 14. Solid-drawn steel pipes can be bent by its aid without any initial preparation, save oiling of the interior. Iron pipes, which are not satisfactory subjects for treatment in the machine, because of the irregularity in contour and wide manufacturing tolerances, are usually bent hot after loading with sand, oil burners being used for the heating of them, and large bending tables provided for the work. Copper pipe bending is done both by hand and hydraulically, the pipes being loaded with pitch, whilst emptying and annealing is accomplished by the aid of oil burners.

The electrical department is supplied with a lathe, a drilling machine, a grindstone, and several small tools necessary for work of a general nature, a hand press with an assortment of dies has been fitted up for turning the tedious work of clip making into a one or two-operation job, according to size, which is simple in nature and quickly performed. For supplying current of a potential twice that of the yard normal which is 110 volts, there is a motor generator for use in the event of its being required for tests and other purposes, and an alternator is attached to the same motor for giving an alternating-current supply, which can be stepped up to a high pressure for flash testing "Reed-Cooper" submersible electric pumps, a speciality of the firm, and such switchgear, connecting boxes, &c., as are made on the premises.

The patternmaking department is accommodated in a very large building, giving ample room for the construction of the largest patterns which the products of the firm render necessary, and the store for patterns, which adjoins the pattern shop, is equally commodious.

Power for the whole of the West Cowes shops is generated in the works by two Mirrlees oil engines and one surface ignition oil engine of the firm's own manufacture. This machine was designed and built for marine purposes, but, to test its capabilities and reliability, it was added to the power station plant when it required augmenting at the time the machinery for the Argentine destroyers was in the course of manufacture. A large Campbell suction gas engine is included in the complement of the generating plant, which, in all, is capable of supplying a total of 475 kW.

Provision is also made to take current from the local electricity supply undertaking when desired. Other power plant includes the White-Forster boiler already referred to for the steaming of turbines, and there is a large cooling tower for the water circulating system of the oil engines and other water cooling duties.

FIG. 14—THE PIPE BENDING SHOP WITH THE BONN BENDING MACHINE

The Registration of Tests.

LAST Friday's meeting in London of the Institution of Mechanical Engineers departed a little from precedent in that it consisted not of the formal presentation of a paper followed by a discussion, but of a so-called "open debate." The subject was "The Registration of Reliable Tests of Power Plant Machinery," and it was introduced by Mr. R. H. Parsons.

As Mr. Patchell informed the members towards the close of the evening, it was originally intended that the subject should be introduced and discussed at an Informal Meeting. The interest of the subject, however, was held to be such as to warrant its promotion for discussion at a General Meeting. It is desirable to complete Mr. Patchell's revelations as to the history of the paper by stating that Mr. Parsons is the Continental Representative of this journal, and that his introductory note to the debate is an amplification of a leading article which appeared in our issue of January 25th, 1929.

Although the evening's proceedings were officially intended to take the form of an open debate, there was, in the event, little or nothing to distinguish them from the customary routine of a general meeting. Mr. Parsons read his introductory note as if it were an ordinary paper, members came forward to discuss it at the platform in the usual way, and at the end Mr. Parsons was called upon in the customary manner to reply to the discussion and defend himself. To at least one independent observer, it seemed clear that the turn given to the proceedings reacted adversely on the full and proper consideration of Mr. Parsons' subject. In the less rigid conditions of a true open debate and still more in the privacy of an informal meeting, it is probable that Mr. Parsons would have received more support for his views than he did in the atmosphere of set procedure and publicity which attends a general meeting of the Institution.

Mr. Parsons' theme was the need for some official registration of authoritative tests of machinery. Such registration, he contended, would secure to manufacturers the credit they deserved, would protect them to some extent from unfair competition, and would furnish designers and others with unimpeachable data concerning what had actually been done by particular machines. He proposed that a registration authority should be set up, preferably under the auspices of the leading engineering institutions and directed by men of known competence and integrity.

He did not seek in any way, he said, to glorify test results. Test figures, even though intrinsically accurate, might be very misleading as a guide to the performance of the plant under ordinary conditions of operation. The results of a short trial could throw little or no light on the trustworthiness, durability, and general handiness of the plant, nor indicate whether the plant was the most economical, commercially, for a given duty. Nevertheless, a properly authenticated test afforded the only possible means of demonstrating that a machine or plant was capable of doing what its makers claimed for it. Test figures interested, technically or commercially, the designer, manufacturer, consultant, and user, and it was therefore essential, if these various parties were to discuss performances with useful precision, that the results should have been obtained under strictly defined test conditions.

The Heat Engine Trials Committee, Mr. Parsons continued, had rendered good service by standardising the methods of presenting the results of tests of power plant machinery and by giving guidance as to the means of determining the figures. What was now wanted was to find some means of securing an equally general acceptance of such test figures as were worthy of belief, so that they could be discussed and reasoned from, without their trustworthiness being called in question. That object, he maintained, could be most easily accomplished by setting up an official register, to the pages of which would be admitted only the records of properly authenticated tests of power plant machinery carried out and reported strictly in accordance with the requirements of the Committee's code.

The members of the body charged with the responsibility for the admission of tests to the register, might, Mr. Parsons suggested, be nominated by the Councils of the leading institutions and trade asso-

ciations concerned with power plant machinery, but no one would be eligible who was professionally associated with any particular manufacturer of such machinery. The registration body would draw up the conditions to be fulfilled in order that a test might be admitted to the register. On application being made to it, it would appoint an experienced engineer to be present at the test, to take no part in it, but to assure himself as far as possible by taking check readings and by a knowing vigilance that the figures were properly obtained and faithfully recorded. The test figures submitted to the registering authority would be considered in the light of the authority's confidential report from its own engineer. Registration would be effected in the name of the authority, and no publicity would be given to the name of the engineer who witnessed the tests. It would be no part of the duty of the authority to express any opinion concerning a test, and particularly any opinion as to whether the plant had or had not met its guarantees. The scheme might at a later date be given an international application by the establishment of an impartial international committee of engineers and the publication of a register of properly authenticated tests carried out in all countries. Meanwhile, however, the British register would be open to all foreign manufacturers who complied with British standards of testing, and who fulfilled the conditions imposed on their British competitors.

Dealing with the advantages likely to accrue from the institution of the scheme of registration which he had outlined, Mr. Parsons said that a manufacturer who could point to tests of his machinery which had been accepted for registration would be provided with most convincing certificates of performance. A few such tests recorded from time to time would put him in a strong position to combat the claims of reckless rivals who had no such evidence to show. Buyers, in turn, could form their own opinion of the credibility of a firm's promises by comparing them with their officially recorded performances. The register would constitute a record, kept continually up to date, of what machines of particular types could really do under stated conditions, and would in due course become an authentic history of technical results obtained. It would do justice to the achievements of the past and would provide a constantly renewed stimulus to further progress. To the designer especially it would be a most useful guide and counsellor.

Lest we have failed to make the point quite clear in this summary of Mr. Parsons' proposals, we would explain that in suggesting the establishment of a register of tests his sole object is not the defeat of deliberate dishonesty or unscrupulousness on the part of manufacturers when testing their products. It would display a lack of knowledge of the world to assert that these qualities never influence the testing of machinery and plant. They are not, however, the sole, and, perhaps, not even the most important factors, the elimination of which Mr. Parsons has in view in suggesting the establishment of a register of tests. We think we may say that he is as much concerned with the fact that at present many perfectly honest tests are carried out which, by reason of variation in the conditions under which they are conducted, cannot be, and should not be, but frequently are, compared with the results of equally honest tests on similar plant conducted by others. He is also concerned with the results of tests which are advanced in all honesty and good faith as an accurate representation of the truth, but which are really erroneous by reason of some undetected miscalculation, oversight, or fault in the means of observation. Finally, he is concerned with the perfectly honest, perfectly accurate test which fails to obtain credence, or which loses much of its value because it has not been confirmed by some authority who has nothing to gain or lose by the good or bad results revealed by the test, but rests solely for its veracity on an *ex parte* assertion.

It is, perhaps, to be regretted that Mr. Parsons himself emphasised the application of his scheme of registration to one particular class of testing, the testing of power plants. His note was titled to cover the registration of tests on power plant machinery, and it was clearly his intention that his scheme should cover tests on condensers, pumps, generators and other separate items which together constitute a power-house as well as tests of the plant as a whole. Mr. W. N. Selvey seized upon the natural difficulty which one man would experience in endeavouring to check the work of fifty to seventy observers stationed at widely separated points when a complete power plant test was being carried out. Other speakers developed this objection to the practical carrying out of Mr. Parsons' scheme. It was not until we had Mr. W. A. Tookey on the platform that the meeting was brought back to the general application of the scheme and was reminded that it was intended to apply not only to complete power plants, but to their details separately and to internal combustion engines and other machinery units, the testing of which was well within the control of one man. It was still later, almost in fact at the end of the meeting, before Mr. S. A. Smith came forward further to rectify the effect of Mr. Selvey's opening remarks. If, said Mr. Smith in effect, Mr. Selvey as a consulting engineer was himself able to organise and control a complete power plant test employing half a hundred observers, then obviously one engineer—it might even be Mr. Selvey himself—appointed by the registration authority could fulfil adequately the duty proposed for him by Mr. Parsons.

Mr. Selvey told the meeting that during the past twenty years he had carried out many power plant tests, and while at times he had seen a slight disposition to make the most of anything to the advantage of the manufacturer he had never witnessed anything which could be described as unscrupulous practice. He had, of course, heard many tales, but he had never encountered their actual practice. But then, as Mr. Parsons did not fail to remark in his reply, Mr. Selvey is not the man with whom anyone bent on deceit is at all likely to take risks.

An argument against the scheme less open to a ready reply was based on the question of the cost involved in carrying it out. The scheme, Mr. Selvey contended, would require behind it a body of the calibre of the National Physical Laboratory, and would, in fact, have to make constant resort to the services of the Laboratory. His own testing work brought him in not more than 5 per cent. of his total revenue. The registration authority, if, as Mr. Parsons had suggested, it was to become self-supporting, would therefore have to force many more tests on manufacturers than they were at present carrying out. Alternatively, it would have to keep its large and expensive staff kicking its heels between tests.

Mr. C. D. Gibb explained a manufacturer's attitude towards this question of the expense of carrying out the scheme. Whatever code was used the registration of the results would involve additional expenditure. Who was going to pay for it—the manufacturer or the purchaser? He admitted that there might be a necessity for some form of registration of test results, but he argued that the principal means for giving it effect already existed in the persons of the makers' and users' test engineers and the consulting engineers. Mr. H. L. Guy could see no solution to the problem of expense except to secure for the proposed registration authority an endowment from what he described as "a certain wealthy and important technical journal."

Mr. Parsons, dealing in his reply with the question of expense, maintained that there would be no additional expense entailed in the registration of test results. If, as several speakers had told them, the tests at present conducted involved much money and required lengthy experience for their organisation, why not complete the work and obtain full value from it by having the results officially registered? Much of the benefit that might accrue to manufacturers was lost by the fact that the test results were not made available to the public.

Several of the speakers developed arguments which, although interesting and inspired by some passing remark made by Mr. Parsons, were not strictly germane to the general subject of discussion, the desirability or otherwise of establishing an authority for the registration of tests. Mr. Gibb defended the practice of extrapolating the results obtained from the testing of one plant or machine to predict the performance of similar plants or machines of different size or working under somewhat different conditions. It was very seldom, he said, that a manufacturer was in a position to lay before a prospective customer the results of a test on a machine of the exact size required working under exactly the same conditions. Pressures and temperatures were continually changing, and it often happened that the only comparable tests which which might be quoted were as much as three years out of date. The practice which Mr. Parsons had described as the "torturing" of test results was, therefore, at times justifiable.

Mr. I. V. Robinson said that the first impression made by Mr. Parsons' remarks was that those connected with the testing of machinery were not invariably to be trusted. If that was really Mr. Parsons' view, how had he come by it? Had he derived it from his experience with continental rather than with British engineers? For his own part he could assure the meeting that he had found continental engineers in every way as trustworthy and scrupulous as British engineers in the matter of test figures.

Mr. B. Pochobradsky argued in effect that the knowledge required for carrying out a proper test on any plant resided in the operating staff of the user and the designing staff of the manufacturer. An independent body could give equally good service only if it contained those people, and therefore the establishment of the proposed registration authority would not essentially change the position in which we were to-day. If the proposed register had been proved to be helpful towards the attainment of more trustworthy results he would have supported it, but that proposition, he maintained, had not been proved.

Mr. Tookey thought it was desirable to introduce some improvements in the methods of tests carried out in makers' works and that there was need for a standard code to govern the testing of small power plant details. He suggested that the Heat Engine Trials Committee might assume the duty, when requested, of certifying that the apparatus used in a works test came up to the standard required for satisfactory results. If the methods of test and the apparatus employed were certified by some controlling body and were adhered to, the results would give less trouble to those who had to make use of them and would be much more comparable one with another than they were to-day. Mr. W. H. Patchell remarked that it paid to have power plants tested, as the results showed the staff what could be done. If, however, the plant was relatively small it would be found too expensive to test it in accordance with the terms of a full code.

On the whole, it may be said that when the discussion did not wander from the strict point it was adverse to Mr. Parsons' scheme for the establishment of an impartial authority for the registration of tests. Mr. Parsons made a vigorous reply to his critics. That he did not allow them to escape unharmed we have already indicated. The nature of the subject and the conditions under which it was discussed undoubtedly prevented us from hearing much that might have lent powerful illustration to the plea for the establishment of a British register of tests. Friendly hostility characterised the attitude of most of those who took part in the debate. It should, however, be pointed out that with one exception all the speakers were either manufacturers of power plant machinery or were consulting engineers concerned with its installation and testing. The attitude of the users of such machinery towards Mr. Parsons' scheme has yet to be expressed.

It frequently happens in debates or discussions—either private or public, in armchairs, round a committee table, or from a platform—that some secondary issue swamps the principal matter. It was so in this case. Rightly or wrongly, Mr. Parsons had advanced as one argument in favour of registration that tests were used for trade propaganda and without that scrupulous attention to accuracy of statement which scientific engineers ought to maintain. Many of the speakers spent much of their time challenging that statement, overlooking the fact that the registration of tests would be valuable quite apart from the prevention of improper use. Motor car builders, for example, have not been slow to appreciate the value of the certificates of performance given by the Royal Automobile Club, and in the past, when trials of steam engines were carried out under the ægis of the Royal Agricultural Society, the manufacturers—and, we may add, users—understood perfectly well the benefits which resulted from a record of good results made under the control of an independent body. Indeed, it may be said without fear of contradiction that whenever tests of any kind have been, or are, carried out by recognised independent authorities, they are always appreciated.

This aspect of the matter escaped the attention of too many of the speakers. They were so anxious to defend the engineering industry from the slightest suggestion of misuse of figures that they forgot that, even with perfect honesty, the registration of test results would be of great value. Had they considered the subject from this point of view the debate might have taken a different turn and would certainly have been more useful.

Skeleton Steam Tables.*

DURING the week commencing Monday, July 8th, there was held in London a conference of various physicists and engineers who are engaged in the experimental determination of the properties of steam or in the organisation of the work. At this conference, which was convened by the British Electrical and Allied Industries Research Association, there were present the following, all of whom are interested in one or other phase of the investigation of the properties of steam :—

America.

Dr. Harvey N. Davis, President of Stevens Institute, Hoboken.
Dr. Dickinson, Bureau of Standards, Washington.
Professor J. H. Keenan, Stevens Institute, Hoboken.
Mr. George A. Orrok, Consulting Engineer, New York.
Mr. Nathan S. Osborne, Bureau of Standards, Washington.

Great Britain.

Professor H. L. Callendar, F.R.S., Imperial College of Science and Technology, South Kensington, London.
Mr. G. S. Callendar, Imperial College of Science and Technology, South Kensington, London.
Professor W. E. Dalby, F.R.S., City and Guilds (Engineering) College, London.
Mr. H. L. Guy, Metropolitan-Vickers Electrical Company, Ltd., Manchester.
Mr. I. V. Robinson, British Electrical and Allied Manufacturers' Association, London.
Mr. F. Samuelson, British Thomson-Houston Company, Ltd., Rugby.
Dr. G. G. Stoney, F.R.S., C. A. Parsons and Co., Ltd., Newcastle.

Germany.

Dr. H. Hausen, Gesellschaft für Lindes Eismaschinen A.G., Munich.
Professor Dr. M. Jakob, Physikalisch-Technische Reichsanstalt, Berlin.

* Report Ref. J/T55 received from the British Electrical and Allied Industries Research Association.

SKELETON STEAM TABLES

Assumed Mean Values and Tolerances.

SATURATED STEAM.

VARIOUS FACTORS.

Temp., °C.	Mean values.	Tolerances, ±
Saturation Pressure kg/cm²		
0	0·00623	0·00001
50	0·1258	0·0001
100	1·0333	0·0000
150	4·854	0·002
200	15·85	0·01
250	40·60	0·05
300	87·7	0·1
350	168·7	0·1
Specific Volume of Liquid m³/kg.		
0	0·00100	0·00000
50	0·00101	0·00000
100	0·00104	0·00000
150	0·00109	0·00000
200	0·00116	0·00000
250	0·00126	0·00001
300	0·00142	0·00001
350	0·00179	0·00003
Specific Volume of Vapour m³/kg.		
0	206·4	0·1
50	12·06	0·01
100	1·674	0·001
150	0·393	0·001
200	0·1270	0·0006
250	0·0501	0·0002
300	0·0218	0·0005
350	0·0089	0·0002
Total Heat of Liquid, International k.cal/kg.		
0	0	0
50	49·95	0·02
100	100·04	0·02
150	150·93	0·03
200	203·6	0·04
250	259·5	0·3
300	321·8	1·0
350	403·7	2·0
Total Heat of Vapour, International k.cal/kg.		
0	595·4	1·2
50	618·5	1·0
100	639·2	0·5
150	656·0	1·5
200	667·5	2·0
250	670	3
300	657·5	5
350	617	7

SUPERHEATED STEAM.

SPECIFIC VOLUME OF VAPOUR, M³/KG.

Temp., °C.	Mean values.	Tolerances, ±
Pressure 1 kg/cm².		
100	1·730	0·003
200	2·213	0·004
300	2·689	0·005
400	3·160	0·005
450	3·396	0·005
500	3·632	0·005
550	3·868	0·005
Pressure 5 kg/cm².		
200	0·4331	0·0006
300	0·5326	0·0006
400	0·6294	0·0006
450	0·6783	0·002
500	0·7242	0·002
550	0·7720	0·002
Pressure 10 kg/cm².		
200	0·210	0·0002
300	0·2631	0·0003
400	0·3125	0·0003
450	0·3367	0·0003
500	0·3604	0·0004
550	0·3846	0·0004
Pressure 25 kg/cm².		
300	0·1011	0·0003
400	0·1224	0·0003
450	0·1327	0·0003
500	0·1426	0·0003
550	0·1523	0·0004
Pressure 50 kg/cm².		
300	0·0465	0·0004
400	0·0591	0·0004
450	0·0645	0·0004
500	0·0698	0·0004
550	0·0749	0·0005
Pressure 100 kg/cm².		
400	0·0271	0·0004
450	0·0305	0·0004
500	0·0334	0·0004
550	0·0361	0·0005
Pressure 150 kg/cm².		
400	0·0162	0·0003
450	0·0190	0·0003
500	0·0212	0·0004
550	0·0232	0·0005
Pressure 200 kg/cm².		
400	0·01028	0·00005
450	0·01312	0·00025
500	0·01512	0·00035
550	0·01673	0·00045
Pressure 250 kg/cm².		
400	0·00636	0·00005
450	0·00940	0·00015
500	0·01136	0·00030
550	0·0130	0·0004

TOTAL HEAT OF VAPOUR, INTERNATIONAL K.CAL/KG.

Temp., °C.	Mean values.	Tolerances, ±
Pressure 1 kg/cm².		
100	639·4	0·1
200	687·5	1·0
300	735·3	1·5
400	783·4	1·5
450	807·7	1·5
500	832·6	1·5
550	858·0	2·0
Pressure 5 kg/cm².		
200	682·5	1·5
300	732·5	2·0
400	781·7	2·0
450	807·0	2·0
500	831·6	2·0
550	857·5	2·0
Pressure 10 kg/cm².		
200	676·2	1·5
300	729·5	2·0
400	780·0	2·0
450	805·0	2·0
500	830·2	2·0
550	856·5	2·0
Pressure 25 kg/cm².		
300	719·8	1·5
400	774·4	1·5
450	800·5	1·5
500	827·7	2·0
550	853·8	2·5
Pressure 50 kg/cm².		
300	700·6	2·5
400	764·0	2·6
450	793·5	2·0
500	822·0	3·0
550	850·0	5·0
Pressure 100 kg/cm².		
400	741·7	3·0
450	776·3	3·0
500	809·5	3·0
550	840	5·0
Pressure 150 kg/cm².		
400	713·9	3·0
450	757·7	3·0
500	797·5	4·0
550	832·0	5·0
Pressure 200 kg/cm².		
400	676·0	2·5
450	736·0	4·0
500	784·0	6·0
550	823·0	8·0
Pressure 250 kg/cm².		
400	622·0	4·0
450	712·0	6·0
500	769·0	8·0
550	812·0	10·0

Geheimrat Professor Dr. O. Knoblauch, Technical High School, Munich.
Dr. W. Koch, Technical High School, Munich.
Geheimrat Professor Dr. R. Mollier, Technical High School, Dresden.

Czechoslovakia.

Dr. J. Havlicek, Witkovitz Iron and Steel Works.
Professor Miskovsky, The University, Prague.

Invitations were also sent to Professor Stodola, of Zurich, who was prevented by ill-health from attending, and to Professor F. G. Keyes, of the Massachusetts Institute of Technology, Boston, U.S.A., who was unable to spare the necessary time.

The conference was opened at 10.30 a.m. on Monday, July 8th, by Dr. Daniel Adamson, President of the Institution of Mechanical Engineers, and was continued under the chairmanship of Sir Richard Glazebrook, F.R.S.

At the start of the conference a general description of the apparatus that they had used was given by the different investigators, and certain information was exchanged regarding the methods adopted for correcting or limiting various errors.

A discussion then took place as to the form in which the final recommendation of the conference should be presented. All delegates agreed that the best solution would be to draw up, in skeleton form, a small table of the properties of steam. To determine each figure to be inserted in the table suggestions would be made by each of the four countries represented, and a mean figure would be adopted, together with a tolerance of an agreed magnitude. It was recognised that in some parts of the table the necessary tolerance might be relatively large, due probably to the different types of apparatus used by the various investigators, giving results departing systematically from the results of other investigators.

A small Committee was therefore appointed to consider this proposal in detail and prepare the desired skeleton tables. This Committee consisted of the following :—

America.—Dr. Harvey N. Davis, with the assistance of Professor J. H. Keenan.

Great Britain.—Mr. G. S. Callendar.

Czechoslovakia.—Professor Miskovsky.

Germany.—Dr. M. Jakob, for saturated steam, and Dr. H. Hausen, for superheated steam.

Mr. I. V. Robinson, of the British delegation, was appointed Chairman of this Committee.

Scope of Skeleton Tables.—It was decided by the Committee, as regards the saturated steam table, to take eight temperatures varying by steps of 50° C. from 0° C. to 350° C., and to determine for each temperature the following properties :—

Saturation pressure.
Specific volume of the liquid.
Specific volume of the vapour.
Total heat of the liquid.
Total heat of the vapour.

For the Superheated Steam Tables it was decided to take a number of pressures varying from 1 atmosphere up to 250 atmospheres and to tabulate, for temperatures varying by intervals of 50° C. or 100° C., the specific volume and total heat of the steam.

UNITS AND CONVERSION FACTORS FOR SKELETON TABLES.

In these Skeleton Tables the following units are used :—

	Unit.	Symbol.
Length	Metres	m
Specific volume	Cubic metres per kilogramme	m³/kg
Pressure	Kilogrammes per square centimetre	kg/cm²
Temperature	Degrees Centigrade	°C.
Total heat	International kilo-calories, which by definition equals 1 kilowatt hour / 860	k.cal/kg

In any international comparison of physical data an element of doubt is introduced by the small differences in the basic units employed in each country, and it was appreciated by the Committee that the units to be employed would have to be considered carefully and stated clearly. Their recommendations are herein detailed and their *raison d'être* briefly explained.

Pressure Conversion Factor.—In obtaining the conversion factor for pressure per unit area from the metric to the F.P.S. system and *vice versâ*, the following have been assumed as basic figures :—

1 pound = 453·5924 grammes.
1 inch = 2·54000 cm.

With these values

1 kg. per sq. cm. = 14·223334 lb. per square inch.

In connection with this point it should be noted that the metric equivalent of the inch employed is intermediate to the British and American legal values. These values are :—

American : 1 inch = 2·540005 cm.
British : 1 inch = 2·539996 cm.

The American value is based upon the definition that the metre is 39·37/12 of a foot, whilst the British value is the result of latest comparison of the standard metre and standard yard, this comparison having been made in 1922–4. This slight difference has no appreciable effect upon the pressure conversion factor, as, if calculated upon the respective metric equivalents this would be :—

British : 14·223329 lb. per square inch.
American : 14·223340 lb. per square inch.

The adopted value 14·223 is therefore accurate to five significant figures on either the British or American basis, and has been used for the preparation of these tables.

In considering the relation between the pound and the gramme, expressed above, the value of "g" does not enter into the calculation beyond ensuring that the same value is used throughout. It is, however, desired to record that the standard value of 980·665 cm. per sec. per sec. has been used.

Specific Volume Conversion Factor.—Based upon the equivalents previously quoted for the inch and the pound, the factor to obtain cubic metres per kilogramme from cubic feet per lb. is—

$$\frac{(12\times 2\cdot 54)^3}{0\cdot 453592\times 10^6}$$

This is equal to 0·0624279 and the value of 0·06243

has been used as being sufficiently accurate. So that we have—

1 cubic foot per pound = 0·06243 cubic metres per kg ;

or, reciprocally—

1 cubic metre per kg = 16·0184 cubic feet per pound.

Heat Units.—Before the appointment of the Committee, the Conference considered carefully the units in which the total heat was to be recorded. It was felt to be very desirable that the adopted unit should be one which would avoid any complication due to the variation in the acceleration of gravity in various parts of the world or the variation of the specific heat of water with temperature, and also that it was desirable to avoid a definition which involved a change in the value of Joules' equivalent with each improvement in calorimetric technique. It was pointed out that electrical units were independent of both "g" and "J," that they were known accurately within very narrow limits, and were internationally accepted, and that therefore it would be very desirable to secure the general acceptance of a heat unit defined in terms of the watt-hour.

This unit, the kilo-calorie, should actually not differ very greatly from the heat units used up to the present time, and should be obtained from an electrical unit by means of a conversion factor which is easily remembered.

A unit defined by the heat equivalent of an international kilowatt-hour divided by 860 meets these claims, and it was accepted by the Conference as a basic unit for these tables, and it is recommended that it should be designated as the international kilo-calorie.

The international kilo-calorie differs from the kilo-calorie used up to now in various countries by less than plus or minus 0·05 per cent., which is an insignificant amount. It has, however, the great advantage of being independent of the determinations of the electrical heat equivalent which differs slightly from one another.

In his work Professor Callendar has used the mean calorie with a value of 4·185 Joules. The German investigators have used the 15°C. calorie with a value of 4·184 Joules ; whilst the American investigators have used the new Bureau of Standards value for the mean calorie, viz., 4·1876 Joules, whereas the unit (kilo-calorie) as defined above has a value of 4186 Joules.

International Temperature Scale.—The Conference adopted the international temperature scale which, as is well known, is determined by the temperature of the ice point, the temperature of ebullition of water under a normal metric atmosphere and the boiling point of sulphur 444·60°C., also under a normal metric atmosphere.

Definitions : (a) *Saturated Pressure at* 100°C.—On the international temperature scale, a temperature of 100°C. is defined as the temperature of the vapour of distilled water in ebullition under a pressure equal to a normal metric (physical) atmosphere. This, in turn, is defined as the pressure corresponding to a column of mercury 76 cm. in height under standard gravity conditions, *i.e.*, g = 980·665 cm. per sec. per sec. and at 0°C. The density of mercury at 0°C. being 13·5955 grammes per cu. cm., the normal physical atmosphere pressure is 1033·258, or, say, 1033·3 grammes per sq. cm. Thus the saturation pressure at 100°C. is defined as being 1·0333 kg. per sq. cm. under standard gravity conditions. This is, therefore, not an agreed value, but a definition, and as such needs no tolerance.

(b) *Heat of Liquid at* 0°C.—The one other definition that has to be mentioned is the total heat of the liquid at 0°C. It has always been the custom of all investigators and authors of steam tables to define the total heat of a liquid or vapour as the heat content in excess of that contained by the liquid at 0°C. and saturation pressure. This latter content is, therefore, zero by definition.

Compilation of Skeleton Tables.

Dealing now with the actual determination of the figures to be inserted in the skeleton tables, each delegation calculated from the determinations of its own members some or all of the figures required for the tables, and these were then compared carefully. In deciding upon the figures to be inserted in the skeleton tables, based upon the various national proposals, due consideration was given to the method in which the figures had been determined. More weight was attached to the figures which were the result of direct experiment than to those which were merely an extrapolation from other work.

The figures thus inserted in the table did not represent a mechanical averaging of the national figures, but were the result of a very careful consideration of the relative values of the different proposals. In this way the figures given in the table and the tolerances attached to each figure were obtained. These values were unanimously accepted by the Conference as representing the first stage in their deliberations.

Since the conclusion of the Conference each delegate has verified or corrected the figures submitted in the Committee, and the skeleton steam tables attached hereto are based upon the confirmed figures.

Further Investigations.—Those figures for which it has been found necessary to allow a comparatively large tolerance were recognised as presenting special difficulties and requiring further detailed experimental investigations. It is hoped that as a result of this further investigation the figures might be varied at a later Conference, so that the range of national values for any one figure may be reduced, and consequently the tolerances also reduced. In addition, at such further Conference values for a larger number of pressures and temperatures may be inserted.

With this step-by-step method of improving the skeleton table and reducing the tolerances, it is hoped that it may be possible in a comparatively short time to get a skeleton table which is accurate within very small margins and accepted by all recognised authorities.

The Committee and the Conference were quite clear that on account of the method employed in setting up the skeleton tables, the values adopted for the total heat and for the specific volume might not be thermo-dynamically consistent in the strict scientific sense, since according to theory all other values can be derived from only two quantities of state—for instance, temperature and pressure—if a perfectly correct equation of state is available. It is also possible that for given values of the pressure and temperature, the values of the specific volume and total heat in the tables might contradict each other. By the choice of large tolerances, however, such a contradiction should be practically excluded.

Should, in the meantime, any nation represented at the Conference, or, it is hoped, others not so represented, desire to produce further steam tables, these should be so calculated that they give values for any property in the steam table coming within the range of tolerances given for that property in the skeleton tables, as there would be considerable doubt as to the accuracy of any figures falling outside this range of tolerances.

It has been felt desirable that some explanation should be given of the methods used in arriving at the figures given in the skeleton tables, as the idea of a tolerance in regard to the properties of steam is novel, but is well suited to the present circumstances.

Once more it is desired to call attention to the fact that the Conference has been confined to those physicists and engineers actually connected with the research work into the properties of steam, and invitations were not extended to others, who, although closely interested in the use of steam tables, are not actually carrying out such research work.

The World Engineering Congress in Japan.

(By Our Special Representative.)

TOKIO, November 9th.

No. II.*

THE Japanese papers, between three and four hundred in number, discuss most phases of modern development ; some are simple accounts of progress in the different industries—the development of the Government Steel Works at Yawata (S. Mattori), a story of persistence in the production of a commodity of first importance under the severest of handicaps, the cost to the taxpayer being tens of millions of yen, and only after thirty years are expenses being paid. Yawata, indeed, is to a large extent the story of Japanese industry ; it has been created at the cost of infinite pains, and at the ruthless expenditure of blood and treasure. The growth of shipbuilding, the copper industry, the conversion of iron ore, the development of coal and ore deposits in Manchuria and Central China ; the history of the old native industries, silk, lacquer, ceramics, are all stories of great interest ; but it is to the field of scientific adventure and experiment that the eyes of the foreign investigator naturally turn. Such scientific papers as have been made available have dealt with a considerable range of topics. One on a new coinage metal which cannot be counterfeited—Dr. M. Chikashige and S. Ueno—contains the statement that Japanese current coins contain twice the silver content of British coins ; a paper which has aroused interest proposes a method of preventing the oxidisation of metals, including iron and steel—Professor H. Endo, Tohoku (Sendai) Imperial University. A film of phosphate of zinc or soda is the remedy, with the aid of a coating of gum or tar. The Japanese have taken to the Diesel engine as readily as to electrical apparatus of all descriptions. Several papers deal with the utilisation of the engine and its comparative efficiency. In this connection, however, the paper of the Congress is that of a Swiss technician resident in Kobe, Mr. Charles Diserens, connected with an Osaka firm, who proposes a method by which the efficiency of the Diesel engine may be increased from 50 to 100 per cent. with a simultaneous reduction in the operating temperature.

Telegraphy and the electrical industry generally claim a good share of Japanese papers. A selective calling device for telegraph offices, involving the reform of the present system—Dr. S. Tanaka—which is designed to dispense with present inevitable delays, is outlined. A system of electric transmission—Dr. Niwa—and spark discharge—Dr. T. Nishi and K. Honda—reveal the study that is being given to the more abstruse subjects of electrical science ; there are several papers on the electric lamp, suggesting improvements.

The development of water power and the means of transmission, the manufacture of transformers and other equipment rank to-day among the heavy industries of Japan. The development of water turbine manufacture—Dr. S. Uchimaru—220,000-volt transmission problems—K. Kato—a 66,000-volt underground cable at Atami sub-station—Y. Sato—are some of the subjects discussed.

The railways in Japan are a world in themselves, the more completely removed from ordinary commerce and industry by reason of the fact that they are a department of the Government, with a Minister of State at the head, although the railway finances are not included in the national Budget.

Papers on railway subjects are contributed by officials of the various railway bureaux ; they treat of railway electrification (Bureau of Electricity), the development of power signalling and interlocking (Communications Section, Bureau of Electricity), current troubles on zoning schemes—these are attracting deep attention, and each is the subject of a paper before the Engineers' Congress.

As in the case of the foreign contributions, a number of the Japanese papers deal with subjects having only a remote relation with the Congress, and none at all with engineering. The Esperantists, who number about 3000 in Japan, have their vigorous propagandists in the persons of Messrs. T. Minoda and K. Takahashi who propose that Esperanto be used at future Congresses, and present facts and figures in favour of the artificial tongue. Another paper which apparently has inadvertently crept into the official Abstract of Papers prepared for the Congress, is an ingenious disquisition on the examination of the mental qualities of inefficient *personnel*, but this, after all, may be ranked with rationalisation and labour-saving devices. Of the latter, there are a number ; scientific management has at last come to the Japanese machine shop (Ordnance Vice-Admiral T. Godo, ret.), and in a very short time the Americans will be feeling themselves back numbers

Reference to the Japanese papers cannot be concluded without mentioning researches in aviation—air currents, winds, and sounds. The Naval Air Service has just concluded the longest sustained flight, a trip to Formosa and back, in Japanese record ; air-mail services now connect the capital with Niigata and other points in the north, with Osaka and points south-westward, with Korea and South Manchuria. Naval and military aerodromes and regimental air headquarters are well established and equipped, and the drone of the plane overhead is as familiar as the horn of the motor car. Other papers cover new flying test methods (R. Fujii), calculation for lift coefficient of a given aerofoil (G. Asano and H. Yamashita), an aerofoil theory regarding propeller turbines and pumps (F. Numachi), safe storage tanks for fuel oils (Dr. K. Mashima), overloading of the aeroplane (T. Ogawa), and, finally, a survey of the work of the Aeronautic Research Institute of the Imperial University of Tokio (Baron Shiba, D.Sc., Dr. Ing.). The plant of the Institute suffered disastrously in 1923, occupying perhaps the worst part of Tokio from the point of view of earthquake risk, facing the bay on the other side of the river, a district that is annually submerged by heavy rains. The Institute now occupies a fine site west of the city, where the best equipment obtainable is installed.

None of the Japanese papers aroused greater interest among the Japanese than Professor K. Muto's paper on the Pagoda, and on the evening of the day he read it—November 4th—almost all the evening papers appeared with pictures of the famous pagoda near Nara, in the compound of the Horyuji. The temple here is reputed to be the oldest wooden building in existence, having recently completed its thirteen hundredth anniversary. Professor Muto pointed out that the gojunoto, which is the name of the Japanese five-storeyed pagoda, had never been known to succumb to earthquake shock. During the great disturbance of 1923, not one pagoda suffered damage, and it remained a puzzle to the Japanese that while lower buildings apparently more firmly placed on the earth were levelled with the dust and destroyed by fire, the ancient gojunoto proudly survived. It is observed by one newspaper that the natural amplitude of oscillation of the great pagoda at Nara is 75 cm. at the summit.

No appraisal of the great mass of engineering knowledge and experience contained in hundreds of papers submitted to the Executive Committee of the Congress is yet possible, for the simple reason that the MSS. have not, at this date, left the printers' hands. There has been ready acknowledgment of the efficient way the Congress was managed and the Sectional Committees put to work, but as a result of the experience gained during the busy sessions, it is most probable that the next Congress will take every paper as read ; will ensure that every paper is available for reading, and will confine itself to discussions of the papers. Not every good author is necessarily a good reader, and particularly is this the case when he is reading in a language not his own.

At the time of writing—November 9th—it is still unknown how many papers will be printed, for proofs are still being read. They may exceed 900, and

* No. I. appeared November 22nd.

there are enthusiasts who affirm that they will number 1000. Of these, overseas delegates, although only about a quarter of the total number of delegates, are responsible for nearly half, and the record in MS. output is held by a British delegate, who has seven papers to his credit. Probably 5 per cent. of the papers are in German, and there are a few in French, but the official languages are Japanese and English. The German papers, however, will have their earnest readers among the mass of Japanese who retain all their old respect for everything German.

It would be impertinent, not to say indiscreet, to attempt to single out the foreign paper of greatest interest. First, because all the papers are not yet published; and, secondly, because of the great diversity of subjects treated. There are papers of purely scientific or technical character, of deep interest to the specialist; there are others of wide general interest, presenting a whole view of some important subject, the engineering aspects being a subordinate feature of the picture presented. Among these must be ranked the survey of the world's iron ore deposits, by Dr. C. K. Leith, Professor of Geology of the University of Wisconsin; the regulation and control of rivers, by Sir Alexander Gibb; rivers and harbours, by General Edgar Jadwin, Chief Engineer of the United States War Department—articles presenting a view of the world's features rarely seen at close quarters. Dr. Leith's survey is of value to the student of politics; by it we see to what extent the great nations have been made great by the gifts of Nature. It may be that the criteria of national greatness may change, as the medium of currency may change, but in this industrial age, the nation without ore and coal is at great disadvantage in the struggle for life, and will always be more or less dependent. Professor Leith's conclusions bring home very forcibly the difficulties of Japan's position and dispose of the popular idea that China has great reserves of coal and iron. He points out that while certain deposits are known in China, their value is discounted by the fact that they are unavailable, inaccessible, and in the aggregate, so far as known, are not of very great extent. What deposits of ore are being worked are controlled chiefly by Japan—those at Tayeh, near Hankow, and at Anshan, near Mukden. There are deposits in the Dutch Indies, and to a smaller extent in the Philippines, but all the deposits in the East can never be of any significance in comparison with those possessed by the great nations bordering the Atlantic basin, in Western Europe, and the Eastern United States. The most extensive deposits are in the Lake Superior region, and these are expected to be at the peak of production fifty years hence.

Similarly, Sir Alexander Gibb's survey of rivers and their control is a fascinating study of one of the great forces of Nature. The mystery of rivers, it might be called, and man's past helplessness against a mighty power; how a great river must be watched and its characteristics studied; and in the lesser rivers, the conflict of interest between the respective local authorities, and the difficulty of managing the river in the interest of the public at large.

There are notable distinctions between the Japanese and foreign papers, and, again between the American and other foreign papers.

The Japanese is first and foremost a student; but he takes nothing for granted. He is not a man of ideas; he is not informative. Long ago, he set himself to study the West, and the study continues, and the West holds him in thrall. The West moves, and Japan is fain to follow—that portion of Japan which is frankly Western and seems to have no tittle of reverence remaining for the ancient gods.

Thus Japan studies and scrutinises and investigates, and is forever "improving" upon something that has come out of the West, which has been dissected and turned upside down and looked at inside out. Whatever the outside world may think of this, there is no room for doubt that Japanese scientists and investigators rank high in the national estimation, and are themselves more than the peers of their colleagues in western lands. The widespread existence of this belief is patent. It forms the subject of articles in the newspapers which are written to meet an undeniable demand.

A number of the foreign papers are devoted to the status of the profession and the subject of training. In this class are the papers dealing with the training of the mechanical engineer (R. W. Allen), the recognition of the engineer (Elmer A. Sperry), the engineer's profession (Axel F. Enstrom, Sweden), and railway engineering (John F. Stevens). Mr. Stevens, who was in control of the engineering section of the ill-starred Siberian expedition of the Allies, organised against the Bolsheviki to support the Kolchak Government at Omsk, tells of the conditions ruling in the early days of railways in the United States, when the engineer was a very practical man, with very little of theory or mathematics, and refers with pride to the ninety years' old stone bridge still carrying the railway and bearing loads fifty times heavier than the load which was supposed to be the limit.

It is not possible to give final figures of the number of foreign papers submitted to the Congress, but it is believed they are considerably in excess of the figures given in the official bulletin.

The committee work of the Congress was divided into eleven sections, and attached to each section was a foreign secretary who acted as liaison officer and furnished the newpapers with brief daily reports of papers read, &c. The names of these attachés follow:

Section I.: J. L. Graham (L. J. Healing and Co., Tokio).
Section II.: F. H. Davies (British Thomson-Houston Company, Ltd., Tokio).
Section III.: J. C. Wynnes, F.R.I.B.A. (H.B.M. Office of Works, Tokio).
Section IV.:—B. M. Murray (English Electric Company, Tokio).
Section V.: C. A. Johnson (Westinghouse Electric Company of Japan).
Section VI.: T. G. Kiff (Yokohama).
Section VII.: W. K. Fowler, jun. (International General Electric Company, Tokio).
Section VIII.: G. Scott (Metropolitan-Vickers Company, Tokio).
Section IX.: Dr. Klingsviehl.
Section X.: A. Buckney (Brunner, Mond and Co., Tokio).
Section XI.: E. Brauns (Gadelius and Co., Tokio).

Authors of papers were requested, when forwarding their MSS., to send abstracts to be published in volume form, and those not received on or before September 30th will not be found in the bulky volume which was ready for delegates on the second day of the Congress. The whole of the papers, printed in full, complete with sketches, diagrams, photographs, &c., will be published at the end of March next, the price being equivalent to about six guineas. There is a great range in the length as well as in the quality of the papers and the variety of subjects discussed. Some authors dispose of weighty subjects in articles less than 1000 words in length; others pay no regard to the limit fixed upon and run to between 20,000 and 30,000 words. The briefest articles come from China; the longest from the United States. National characteristics stand out in all papers. The formidable Italian literary contribution, over eighty papers, although Italy has only thirteen delegates, seems radiant with the spirit of Mussolini—an Italian renascence in industry is obvious; a sense of great achievement inspires them. And everything is the State, represented in the supreme personality of the Premier. There is nothing of the traditional Latin sentiment in the Italian papers; for that quality we must now look to the new world.

At the other extreme are papers written by United States citizens. If the subject be mineralogy, we find reflections upon the profound influence of minerals upon the fates of nations, and quotations from the poets—British writers, for the herald of empire has not yet appeared in United States literature. American papers are entertaining, as well as informing, and of the latter quality they give full measure, the authors having much to say of conditions of life of which the world without really knows little. But whether the subject be oil or ore, minerals or irrigation, through all the discourse runs the fine silken thread of sentiment, evoked by a consciousness of the richness of the national possessions and the duty the United States owes to a world less richly endowed:

> "Ah, then shall all men's good
> Be each man's rule, and universal peace
> Lie like a shaft of light across the land
> And like a lane of beams athwart the sea."

INDIVIDUAL PAPERS.

Engineering opinion, so far as it is publicly expressed, acclaimed the paper of a Swiss engineer as one of the most remarkable contributions to the Congress. The author is Mr. Charles Diserens, connected with the Nichizui Trading Company, of Osaka, a concern established following the discontinuance of trading in this country by Samuel Samuel and Co. The title of Mr. Diserens' paper is "On Supercharging of Diesel Engines, particularly Büchi-exhaust Turbo-charging." The reporter attached to the committee which heard this paper described it as the "sensation of the gathering," delegates being agreed that the advances in oil engine design described in the paper were almost certain to revolutionise that field of engineering. In the discussion which followed, it was asserted that the exhaust turbo-charging described seemed certain to add from 50 to 100 per cent. to the already high efficiency per pound of the oil engine. Mr. George Scott, reporter for this committee, further states:—

"High efficiency, it is said, is obtained by emptying the cylinders of the exhaust gases at the end of the expansion stroke to a very high degree, owing to the pressure fall at this point; filling up the entire compression space with clean and relatively cold air; blowing through the cylinders when the piston is at its top position a large quantity of scavenging air; and choosing the pressure fluctuations in such a way that the minimum pressure in the exhaust pipe takes place at a time when the piston is moving very slowly. This method cools the inner walls of the cylinders, and the valves are thus very effectively cooled by the cool scavenging air, all the exhaust gases are blown out of the cylinder, much more fresh charge, at a lower temperature, is taken into the cylinders than is the case with ordinary Diesel engines. There is a large excess of combustion air at all loads."

Continuing, the reporter says:—

"The actual Büchi exhaust gas turbo-charging system is a combination of a supercharged Diesel engine, but producing the full useful output, and of an exhaust gas turbine serving only to drive the supercharging blower. With this arrangement, the Diesel engine and the exhaust gas turbo-supercharger are mechanically quite independent of each other, being interconnected only by the exhaust gas and air piping. The great advantage of exhaust gas turbo-supercharging, said Mr. Diserens, is the possibility of maintaining within very large limits a very large excess of air. This is easy, as the exhaust gas turbine operates at variable speeds, depending upon the load conditions of the engine."

At the first session of Section IX. Professor Hillhouse took the opportunity of congratulating Mr. Y. Yamamoto on his paper dealing with recent developments in marine engineering—referred to earlier in this survey. Professor Hillhouse remarked that he looked back with a good deal of pride upon his sojourn as a professor of engineering in Japan more than thirty years ago, when he was partly instrumental in starting Mr. Yamamoto upon his career. The Professor's own paper, "Shipbuilding in Great Britain," was read at this meeting.

The seniors among both the American and British delegates, and continental delegates also, had interesting meetings of this pleasant character with old students who have since become leaders in their native country.

Papers on standardisation and rationalisation aroused much general discussion, Czechoslovakian, Italian, and United States writers combining in an interesting symposium on this broad subject. In the discussion following the reading of his paper on standardisation, Mr. C. E. Skinner (United States), Baron Shiba, a Vice-president of the Congress, emphasised the need of the spread of standardisation, and pointed out that neither the United States nor Great Britain were as yet members of the International Standardisation Association.

In his paper on the Movement for Rationalisation in Europe, Dr. Francesco Mauro (Italy) observed that Germany was the country where rationalisation had been carried out in the most scientific manner in Europe; and through the influence of the Premier, the movement was making headway in Italy, the following measures to foster rationalisation having been initiated by the Government:—

> Avoidance of over-industrialisation by limiting the number of new factories in the towns, and encouraging certain industrial regions;
> Promoting the organisation of agriculture by systematic drainage, improvement of transport, and the extended use of electric light and power;
> Balancing the national productive forces of the nation and so avoiding "hypertrophies" and "deficiencies."

It is expected that the progress of the rationalisation movement will be stimulated by the next meeting of the Consultative Economic Committee of the League of Nations. A Swiss paper was read by proxy on the International Federation of National Standardising Associations; one on Standardisation in Germany (Dr. F. A. Neuhaus); and a third on Engineering Standardisation in Japan (S. Konishi). In line with standardisation and rationalisation schemes was the proposal advanced by Dr. Stanislav Spacek, Councillor of the Department of Public Works, Prague, for the foundation of a federation of world engineers which, being supported in principle by Baron Shiba, on behalf of the Japanese, and Mr. Ranislav M. Avramovitch, President of the Jugoslav Association of Engineers and Architects, was referred to the next general meeting of the Congress.

(To be continued.)

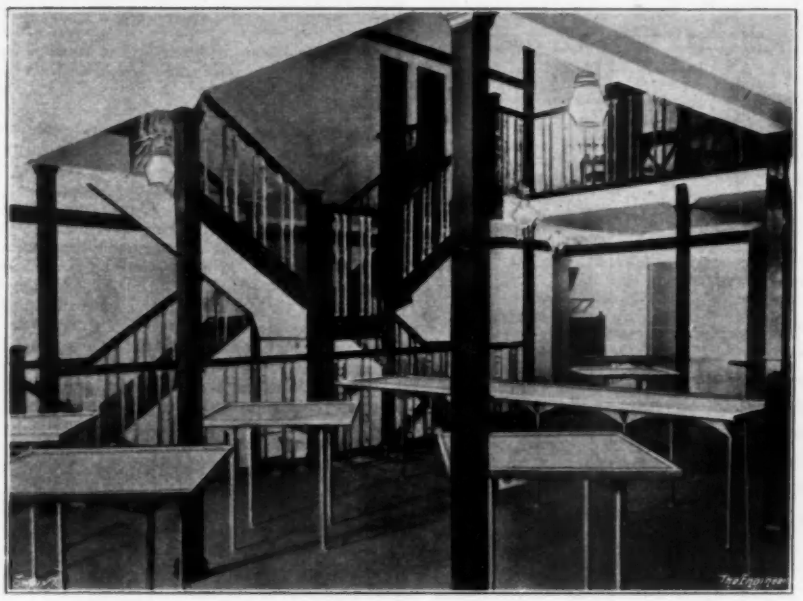
H.M. Airship R 100.

ON November 22nd the airship R 100 was taken over for flight trials by the Air Ministry from the contractors, the Airship Guarantee Company, Ltd., a subsidiary of the Vickers group. Unlike the R 101, which was built at Cardington by the Royal Airship Works, the R 100 has been constructed by a commercial undertaking, which accepted the contract as a matter of business. The contract price was £300,000, together with a capital grant of £50,000 towards the expense of erecting or acquiring a shed in which to build the vessel. The contract also gave the constructors the option of purchasing the vessel when completed for £150,000 for use on an approved British airship transport service. It is no secret that the company has lost heavily on the contract. Its managing director, Sir C. D. Burney, has stated that the vessel has cost his company £450,000 to build. It is also no secret that the company does not intend to exercise its option to purchase the vessel at half the contract price. The cost of the R 100 may be compared with the sum of £474,000 given in the Air Estimates as the sum expended on the construction of the R 101. This figure is exclusive of the cost of the Beardmore heavy oil engines, five of which are used to drive the R 101. The figure to be added for the engines is £53,000. The actual final cost of the Government airship is expected slightly to exceed the estimated total of £527,000 indicated by these figures.

The R 100 has been built at Howden, Yorkshire,

in a shed erected during the war by the Armstrong, Whitworth airship department. It was specified in the contract that the vessel was to have a gas capacity of not less than 5,000,000 cubic feet, that on her flight trials she was to maintain a speed of not less than 70 miles an hour at an altitude of 5000ft., and that her total fixed weights were not to exceed 90 tons. It was also required that living and sleeping accommodation was to be provided for at least 100 passengers, that the ship was to be navigable within certain defined angles of pitch, that she was to comply with the general requirements for airworthiness laid down by the Aeronautical Research Committee, and that during her construction she was to be subject to the inspection of the Aeronautical Inspection Directorate. These requirements were substantially identical with those imposed on the Royal Airship Works in connection with the building of R 101. Subject to them, each designer was given a free hand to embody his own ideas in the vessel. The chief engineer and designer of the R 100 is Mr. B. N. Wallis. He has produced a vessel which in several important respects is quite different from the design evolved by Lt.-Col. V. C. Richmond for the R 101.

At one time it was intended that both the airships should be driven by heavy-oil engines. Because, however, or so we understand, of the difficulty of obtaining in time the requisite number of heavy-oil engines, the R 100 has been fitted for the present, at any rate, with petrol engines. This fact will probably preclude her employment on the Indian route and is likely to result in her flights being confined to cool climates, including Transatlantic voyages. The vessel's engine equipment consists of six Rolls-Royce "Condor" III. B engines, each developing 660 horse-power. The engines are arranged in tandem pairs in two wing cars and one central line car swung from the framework. Of each pair of propellers the after one is reversible through gearing. The total forward power of the airship is therefore 3960 H.P., of which half—neglecting the loss of efficiency of the gearing—is available for reverse motion. The vessel is therefore much more highly powered than the R 101, which carries five 585 H.P. engines and which at present employs four of these engines for forward propulsion and one exclusively for reverse motion.



PORTION OF THE DINING SALOON OF R 100

The three engine cars of the R 100 are all arranged aft of the passengers' quarters, with the object of minimising the noise heard. The arrangement of the after propellers in the slip stream of the forward tractor screws must result in a loss of propeller efficiency. That loss is, however, held to be compensated by the saving in weight obtained by the installation of two engines in one car and by the reduction in the number of crew required, which this twin arrangement renders possible. The two wing cars, in addition to the main engines, are each fitted with a six-cylinder engine driving a 15-kW generator for supplying current for the lighting, heating, cooking, and wireless services. Each of the three cars is equipped with a "Bristol" gas starter for the main engines.

The design of the engine cars is of interest. Each car consists of a central section slung from the ship's hull and containing all the controls, auxiliary machinery, oil tanks, radiators, &c. The forward and after sections are bolted to the central section and consist of the engine, or the engine and gear-box covered by a fairing. These sections can readily be detached should it be necessary to change an engine. When this operation is being carried out a two-legged derrick can be fitted on the centre section and by means of a chain purchase either engine section can be lowered by men stationed in the centre section. By this arrangement it is hoped to be possible to effect the changing of the engines when the airship is riding at the mooring tower. The forward engine and fairing weighs ¾ ton. The after section with the gearing weighs 1 ton. Access to the engine cars is obtained from the hull interior by means of a folding streamlined ladder.

The passengers and crew are accommodated in a three-decked compartment slung inside the hull at a point forward of its maximum diameter. The compartment is separated from the gas bags by a double wall of fabric through which air is circulated. The lower deck is allocated to the crew. On the middle deck there is a dining saloon with fifty-six seats and having an area of 864 square feet, and two promenade decks, each of 360 square feet area. From the dining saloon a double stairway leads to the upper deck, on which there are two balconies, each of 105 square feet in area and a lounge in the form of a gallery round the dining saloon, the area of this lounge being 540 square feet. On the second and top decks there are also sleeping cabins containing a hundred bunks. Most of the cabins have four berths. Projecting outside the hull beneath the crews' quarters is the control car.

The vessel has a length of 709ft., a maximum diameter of 133ft., and an overall height of 135ft. Her gas capacity is just over five million cubic feet and gives an estimated lift under standard conditions of 156 tons. The hull framework is made entirely of duralumin, unlike that of the R 101, in which stainless and high-tensile steel play the principal part. The framework consists of sixteen sixteen-sided main transverse frames joined together by longitudinal girders. In the R 101 the transverse frames are designed to be inherently stiff without bracing and measure 10ft. 6in. in the radial direction. In the R 100 the frames are only 2ft. 6in. in the radial direction and are braced by radial wires running from the corners of the polygon to a central fitting. Cross bracing shear wires are fitted in the longitudinal panels between the main frames.

At the centre of the hull framework an axial girder runs from end to end of the vessel, passing through the middle of each gas bag. From frame No. 1 to frame No. 13 this girder is triangular in section and to it are bolted the centre fittings for the radial bracing wires of the transverse frames. From frame No. 13 aft the central girder is of square section and forms part of the structure of the tail planes. Forward of frame No. 1 the structure is specially strengthened to take the bow mooring attachment. Aft of frame No. 15 the hull is faired off by a tail piece of Zeppelin type girders.

The girders comprising the transverse frames and the longitudinal girders by which the frames are joined together are triangular in section and are composed of tubular booms united by bracing pieces. The booms are composed of duralumin strip wound spirally into a tube form on a special machine, the spiral overlap being riveted. Ease of assembly or replacement has been kept prominently in view in the design of the whole framework. Each main transverse frame is assembled from sixteen transverse girders by means of ninety-six units. Two transverse frames are joined together by sixteen longitudinal girders by means of an equal number of nuts. Standardisation of the parts of which the structure is composed has also been closely studied. In the whole of the hull, tail plane and passenger quarters structures there are only about fifty different standard parts employed. In this respect the vessel differs materially from R 101, in which the structure is characterised by the large number of similar parts employed with slightly different dimensions or angles from part to part.

Externally the vessel differs in a minor but interesting respect from R 101. The transverse frames of the Government vessel are fifteen-sided, but between each pair of the fifteen longitudinal girders which unite two adjacent frames there is a longitudinal reefing boom which is adjusted in or out to keep the outer fabric cover taut. The result is that the R 101 is in section thirty-sided or in effect practically circular. In the R 100 the outer cover is kept taut by an inward pull applied to it by a system of internal wiring. In section, therefore, the cover is composed of sixteen concave arcs. The covers of the control planes are tautened in a similar manner. Wind tunnel experiments have shown that a body of the streamline shape of R 100 is subjected to external suction when in flight except for a portion of its length near the bow, and at the after end. The internal tautening arrangement for the outer cover is therefore well adapted to support this suction effect. Where pressure and not suction is in existence the outer cover is braced internally with tapes so disposed as to help the cover to support the pressure.

There are fifteen gas bags in the vessel. The bags are made of a single thickness of cotton lined with two layers of goldbeaters' skins, which are assembled in large sheets and glued to the cotton by a special process. The bags are varnished internally and externally and sprayed with aluminium dust to protect them against humidity effects. In the case of R 101 the bags were made at Cardington, but as the Royal Airship Works were unable to make the bags for both vessels and as no firm could be found in this country with the requisite plant and knowledge for the manufacture of the bags for R 100, the work was done abroad by the undertaking which manufactures all the bags for the Zeppelin Company. The total area of the bag material in the vessel is 55,800 square yards, or over 11 acres. The largest bag has a capacity of 550,000 cubic feet, weighs 1580 lb., and has a gross lift of 16·7 tons.

Automatic gas valves are fitted at the bottom of the bags. The gas discharged from these valves is led through a fabric trunk to the top of the vessel, where it is discharged into the air. Hand-controlled valves are fitted at the top of the bags and are operated from the control car in order that the captain may adjust the lift when required.

For her trial flights the vessel will be fitted with thirty-two 250-gallon petrol and oil tanks, but provision is made for the carrying of many additional tanks on long demonstration flights. The fuel and oil are transferred by hand-operated Zwicky pumps from the storage tanks to gravity-feed tanks situated above each engine car. Ten tons of water ballast are carried in emergency or quick-discharge bags and up to 16 tons in slow-discharge bags. The slow discharge bags will be used chiefly to deal with the diurnal change of lift caused by change of atmospheric temperature and conditions when the vessel is at the mooring tower. All the bags can be filled from a water main running the whole length of the ship and connected when the vessel is moored to the tower water main. Four 1-ton tanks are provided for fresh water storage for the use of the passengers and crew. In an emergency petrol can also be discharged from any of the fuel tanks to assist in lightening the vessel. On page 608 three views of the vessel will be found.

The Art of Water-Drawing.*

By RHYS JENKINS, M.I. Mech. E., Past President.

IT has been decided by the Council that the next Extra Publication of the Newcomen Society is to be a facsimile reprint of a rare seventeenth-century book on pumps and water-raising apparatus, and the object of this paper is to introduce the little book to the notice of the members. The heading, "The Art of Water-Drawing," is the title of the book as it was issued in 1660, but the work made its first appearance the year before with a different title-page. With this matter and on the question of authorship it is not proposed to deal here; however, it should be stated that the name of the author does not appear on the title-page and the preface is signed "R. D'acres."

A striking feature of the book is the systematic treatment of the subject. The author analyses the machine into prime mover, transmitting mechanism, and operating member. Then he divides the prime movers into animate and inanimate; the animate into men and beasts, and the inanimate into wind, water and so on. He similarly classifies the transmitting mechanism, and the devices for raising the water. The present writer cannot recall any other instance of so early a date in which the parts of a machine are thus systematically set forth. The older authors usually found it necessary to illustrate and describe an entire machine in order to put before the reader one part only differing from some previously described machine.

The types of water-raising apparatus mentioned are:—The bucket gin, the sucking pump, the forcer and bellows gin, the chain pump, and the archimedean screw;[1] and, curiously enough, his favourite seems to be the last. He recognises that it can be used only for low lifts, but points out that a number of screws may be used in series to get the height desired. It is doubtful whether the archimedean screw was in use in English mines at this period, but it was employed for drainage in the Fen Country, and the author, no doubt, had seen it in use there and been im-

* The Newcomen Society for the Study of the History of Engineering and Technology, November 20th, 1929.

[1] Bucket wheels also are described in the section dealing with water wheels.

pressed by its simplicity, sweetness of action, and freedom from breakage, and in his main classification he puts it by itself as a kind which "fairly intreat and tacitly court the water upward," while the others belong to the kind "such as roughly Compel and force the water to ascend."

The author considers that the most ancient instrument for raising water is the bucket gin, *i.e.*, the chain of buckets, and says "there be infinite sorts of them." The buckets are made of leather or of wood; or they are in the form of barrels; the apparatus is then termed a "barrel gin."

Of the sucking pump, which he regards as the next in antiquity, he tells us that the barrel should be of larger bore than the pipe below it, and points out the limit of depth from which water may be drawn; to draw from a greater depth the bucket should be lowered in the pump, "for otherwise the water will not follow after, though you suck never so strongly and sucker it never so closely." He concludes with the statement, "It is much better to lift a foot of water than to suck or draw a foot."

The next division is "Forcers." They are stated to be useful specially for narrow crooked places, but they are "very apt to be sludged." In advising that the delivery pipes should not be made too small, the author makes use of the term "wyer-drawing," a very early example as applied to fluids.

Of the chain pump we are told that it will lift 10 or 12 fathoms or more, will not sludge, and that the bore should not be more than 5in.

The chain pump was the apparatus in most general use for raising any considerable body of water and for continuous operation in mines, &c., it was also in use in ships. The barrels were still of wood, as they were described by John Bate, a quarter of a century earlier.[2] Bate, however, informs us that the lower end of the uptake barrel was lined with brass, and there can be little doubt that it is these linings that we find referred to in 1553 as "two sockets of brasse made by the advyse of Lewys the plomer for the pomping of the water oute of the pyttes at Wollatton." In the early part of the seventeenth century, it was stated that there were three chain pumps employed at the Wollaton pits, that they were of 4in. bore, and that the lift was under 15 fathoms.[3] It was a chain pump that Bevis Bulmer applied at Broken Wharf in 1594 for raising water from the Thames for a public supply to a part of London. Bulmer was the great mining engineer of his day, and he would naturally make use of the construction that he had found most satisfactory in practice.

When the chain pump was first introduced is not known, and some of the early references leave us in doubt as to whether a chain pump or a chain of buckets is in view. Clearly, however, the apparatus with "two great iron chains," set up in 1492–3 at a coal pit in the Tyne district was a chain of buckets, for it was used for drawing both coal and water. However, there is some reason for thinking that in these early days the Tyne was rather behind some other districts of England in regard, at any rate, to water-raising appliances. It is possible that it—*i.e.* the chain pump—was introduced from Germany in the sixteenth century.

The early history of piston pumps, whether sucking or forcing, is even more obscure. We have remains of Roman pumps found in this country, but, like other objects of Roman civilisation, these went out of use with the coming of the Saxons. According to the Oxford English Dictionary, no trace of the name "pump" occurs before the fifteenth century, and it is not recorded in Dutch, Low German, or High German before the sixteenth century. We have it about 1440 in "Pumpe for a schyppe," and from then on to the end of the century there are frequent references to pumps for ships. In 1490 we have the variant form "plump," the reference being to a "plumpmaker" of Bristol. Then in 1507 we learn that a pump cost 33s. 4d., and in 1515 26s. 8d., and in 1534 that "pump shoes" are 4d. each, while in 1550 3s. 4d. is paid for "plats ot Ire to amend the boxe of the plumpe—and labour abowte the same," for a well at Plymouth. Clearly, all these references relate to appliances for raising water, but of what sort we are left to surmise. Probably for the most part they refer to suction pumps. When Bulmer's chain pump was put up at Broken Wharf at the end of the sixteenth century, it was known as "an engine." Bate, in 1635, applies the term pump only to the sucking pump. Our present author applies it to the sucking pump and to the chain pump. Apparently, we can rule out the force pump, neither author calls it a pump. It is a "force" or a "forcer." It would seem that this form of apparatus was not in use in England until towards the end of the sixteenth century. The first well-known application is that by Peter Morrice at the London Bridge waterworks, but there is a somewhat earlier example of its use. In 1601 there was a judicial inquiry in regard to a "certain force" that had been put up by Sir Nicholas Bacon "to force and supply water from the stream . . . to his house called Gorhambury." Now Sir Nicholas died in 1579, so the force must have been erected before that, possibly only shortly before his death, and by Morrice himself, who was in this country in 1577, if not earlier. He obtained his patent in January, 1578, and was at work on the London Bridge plant in 1580.

On the whole, then, it would seem that we shall be safe in saying that some crude form of suction pump was in use in England, at any rate as early as the fifteenth century.

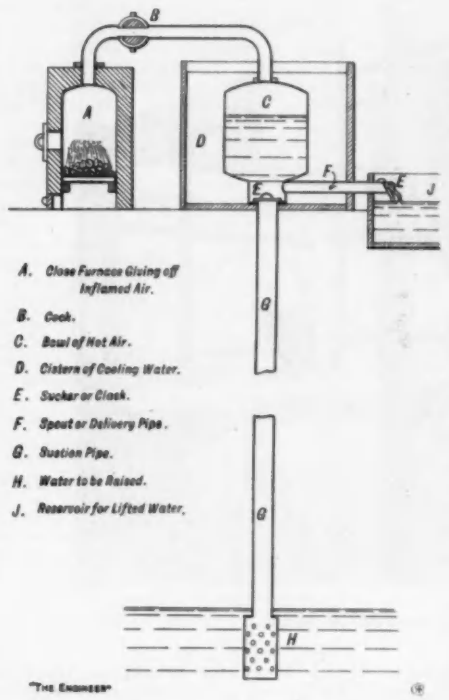
To us to-day it may seem a surprising thing that with the suction pump known and in use, the chain pump was the form most commonly used in mines, *i.e.*, in the seventeenth century. A little consideration will show that with the materials and mechanical skill then available, it was possible to make a far more satisfactory and enduring construction in the one form than in the other. For the chain pump, wood, the material then in use for the barrels or cylinders and the pipes, served pretty well—particularly when the barrels were fitted with metal linings at the lower end of the bore—for a series of flexible pistons or plugs following each other through it in the same direction. Apart from breakage of the chains, there was nothing to go wrong, save the plugs, and they could be renewed or repaired without removing the chain.

With the suction pump, on the other hand, a reciprocating piston in a wooden cylinder at once suggests trouble in working, and the necessity for frequent attention; then the valve-box and its fixing to the barrel must have been a source of difficulty, and so also the piston, whether made in the earlier form of a shoe or cone of leather or of a wood or metal disc with valves.

However, in spite of these drawbacks, the suction pump was in use, even in mines. It served its purpose where pumping was required only at intervals, or the quantity of water to be raised was small.

It was the introduction of cast iron that led to the general extension of the use of the suction pump, and this began at the close of the seventeenth century and went on during the eighteenth. It would seem that Morrice in 1580 had used metal barrels; at any rate, Bate in 1635 refers to them as of brass or iron. It is unlikely that at this date they were of cast iron, but they may have been cast in brass. In any case, the pumps were quite small. The earliest reference to cast iron barrels appears to be that found in the advertisement of a London ironfounder in 1700, in which it was announced that he made, among a number of other things, "cylinders for water works." About this time the London Bridge waterworks was being reconstructed by Sorocold, and, as described by Beighton in 1731, the pumps had cast iron cylinders 7in. bore, and four-throw crank shafts of the same material. It is likely that the ability of making use of cast iron was an important factor of Sorocold's great success as a water engineer. So far as we know, he used piston pumps in all the pumping plants he put up for public water supply, and beginning at Derby in 1693, they amounted to about a dozen. Naturally the use of cast iron came in but slowly. A Newcomen engine put up in Scotland in 1725–27 had two cast iron barrels, 9ft. long and 9in. diameter, but the pipes below were of elm. About the same time Switzer, writing of water pipes, states that cast iron is "now growing into great use." However, it is not until the last quarter of the eighteenth century that it can be said that the material had come into extended use.

To return to our book. Perhaps the most surprising thing to find in it is the suggestion of the use of fire for raising water. Unfortunately, there are no illustrations,


A. Close Furnace Giving off Inflamed Air.
B. Cock.
C. Bowl of Hot Air.
D. Cistern of Cooling Water.
E. Sucker or Clack.
F. Spout or Delivery Pipe.
G. Suction Pipe.
H. Water to be Raised.
J. Reservoir for Lifted Water.
"The Engineer"

FIRE PUMP *circa* **1660**

but the author's description of the apparatus is clear, and from it a diagram has been prepared. It will be seen that he has a closed vessel or bowl immersed in a cistern of cooling water and placed at the upper end of a pipe, provided with one or more clacks, going down the well or shaft below the surface of the water to be raised, a furnace connected to the bowl by a pipe furnished with a cock and a delivery pipe from the bowl provided with a clack. The apparatus acts in this way:—Assuming that the bowl is charged with water, the turning of the cock allows the entry of the heated gas and the water is expelled from the bowl drawing the used charge of gas after it. When the bowl is full of hot gas, the cock is closed, the cooling water then causes contraction, a partial vacuum is formed; whereupon the atmospheric pressure forces up the water from the well into the bowl. Then the gas cock is again opened, and so on. Two sets of the apparatus are to be used to get a continuous flow, and for depths of over 10 yards the apparatus may be used in series.

Now this is not the earliest suggestion of the application of heat to raise water. The names of Porta, Decaus, and Ramsay will at once occur to you; but from the way in which the author approaches the subject—he shows, on the one hand, how the heat of the sun raises water from the sea to the clouds, and, on the other, how liquids are raised in distilling apparatus, and reasons that between the two it should be possible for man to devise a water-raising apparatus answerable to his needs—it seems clear that he was not aware of the earlier schemes, and, at any rate, he is the first Englishman to give a description of such apparatus, for although David Ramsay had his patent thirty years earlier for an invention "to raise water from lowe pits by fire," we know nothing whatever as to the construction of his apparatus and not much about the man. Between the years 1618 and 1638 his name figures in eight grants of patents. In most of these he had partners, but in that referred to above he was the sole grantee, so it is to be presumed that he was the inventor.

Our author, it will be observed, uses the hot gases from a furnace, whereas Porta had used steam. This may appear a step in the wrong direction, but it must be understood that it was not clearly, or at any rate generally, known at that time that steam and air were different substances. As late as 1734 we find the Swedish engineer Triewald contending that "the steam which is allowed to pass into the cylinder is nothing but moist air, heated to a high degree, every particle of air being surrounded by an incomparably thin membrane or coat of water, very much like a bladder,"[4] and Triewald was a man of science, well educated and well-read.

The great distinction between D'acres and Porta or Decaus is that he relies on the pressure of the atmosphere to force up the water, whereas they work by the pressure within the reservoir. However, even on this point, our author is not the first in the field. In 1655 there was published in Paris a work entitled "La Science des Eaux,"[5] written by Jean François, a member of the Society of Jesus, in which is described apparatus working in this way. D'acres, however, approaches the subject from a more practical point of view, and his apparatus is better thought out. He provides a separate furnace for heating, and effects the cooling by water, neither of which features are found in the French book.

One would be glad to know whether D'acres ever constructed and tried the apparatus which he described, but research has failed to reveal any information on this point, or even to establish with any certainty the identity of the author. Perhaps, however, enough has been said to show what an interesting book he produced.

[2] John Bate, "The Mysteries of Nature and Art," 1635.

[3] Hist. MSS. Comm. Middleton MSS.

[4] Mårten Triewald's "Short Description of the Atmospheric Engine," 1734. Newcomen Soc. Extra Publication, 1928.

[5] There was an earlier issue of the book, Rennes, 1653. This the present writer has not seen.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE GRIMSEL HYDRO-ELECTRIC POWER SCHEME.

A CHARA,—I am directed by the Minister for Industry and Commerce to refer to an article on the above scheme in the last issue of THE ENGINEER, containing a table which purports to give the comparative costs for the Grimsel works and the Shannon works. This table appears to have been compiled on an entirely mistaken basis, inasmuch as the figure given for the cost of the Shannon works includes the cost of all the transmission lines, low-tension distribution systems, house connections and other expenses of delivery to the actual consumer, while the figure given for the Grimsel works appears to include only the cost of works in and about the power station. The cost of power at the station bus-bars for the Shannon—based upon the minimum power estimated to be available in the driest year from a record of thirty years—is ·47d., and this would appear to be the proper figure to compare with the figure of ·352d. for the Grimsel station.

The Minister would be obliged if you would insert this correction in your next issue.

GORDON CAMPBELL.

November 28th.

[We are informed by Messrs. Escher Wyss and Co. that the four Pelton turbines of 30,000 H.P. at 500 r.p.m. for the Handeck power station are being supplied by them, and that Messrs. Oerlikon are only supplying the directly coupled 25,000-kVA three-phase alternators—not the turbines as well, as stated in the article.]

WIRELESS WAVE TRAP.—We have received from Dubilier Condenser Company (1925), Ltd., of North Acton, a neatly constructed wave trap for the elimination of 2LO. The unit consists of a moulded bakelite box containing a toroidal coil and an adjustable condenser of the moving vane type with mica dielectric. Outside the box are two terminals covered by a bakelite lid, which can only be removed with the aid of a screw-driver. The usual connections are made to these terminals, then the cover is replaced. We suggest that it would be convenient if a push-pull shorting switch were incorporated, as it would then be possible to tune in 2LO without the trouble of disconnecting the unit. On test we found that the unit was effective, like all wave traps, over a certain range on either side of the eliminated station. But as that range is passed the station comes in again with increasing strength. A trap that will, say, in London, completely eliminate 2LO all round the dial is still needed.

COPPER SHEETS FOR ENGRAVING—Since the method of reproducing illustrations by means of process engraving was first invented, the United States has been practically the sole source of supply of the copper sheet required for the process. To prepare them for use the sheets have to be rolled to a fixed gauge and then ground and burnished until a true and highly polished surface is obtained. Hitherto no other country has been able to compete with the United States in supplying these sheets. A new type of rolling mill has, however, been devised at the Prescot Works of British Insulated Cables, which will produce the sheets so exact to gauge and with such a perfect mirror-like surface, as to need no subsequent grinding or buffing. Besides saving a considerable part of the production cost, the rolling mill is said to produce sheets far more accurate in gauge and much more durable than those produced in the United States. Already, we are told, these advantages have enabled the British manufacturers to capture practically the whole of the home and continental markets and, to a large extent, to oust the Americans from the Canadian market. When the first consignments of these sheets arrived in Canada, the Canadian Custom Authorities refused to clear them on the ground that they were incorrectly described on the invoices. They declared that the highly polished surface could not possibly be produced without grinding and buffing after the sheets left the rolling mill, and in this contention they were supported by American producers. It was not until the authorities had satisfied themselves that the British sheets possessed the desired properties, by investigations at the Prescot Works, that the consignments were released without penalty.

Railway and Road Matters.

ON Sunday last, December 1st, the Southern Railway Company opened a new signal-box at North Kent East Junction, which, together with the provision of colour light automatic signals, between London Bridge and New Cross, allows five signal-boxes to be dispensed with.

THE pilots employed in the transcontinental air service of the Pennsylvania Railroad are assisted in their work by meteorological reports sent by telegraph operators at fourteen points on that system. These men have been trained to read the thermometer, to judge of wind velocity, to estimate vertical and horizontal visibility, and to forecast the weather from the clouds.

THE railway accident figures each year are very much swollen by the inclusion of accidents in goods warehouses, engine sheds, &c., which really are of an industrial character. How minor they are is shown by the fact that out of 256 servants killed last year only 40 were of men so employed. On the other hand, out of 18,471 injured, 15,344 were the result of these non-movement accidents and 14,829, or 96·64 per cent. of that figure, were ascribed to misadventure or accidental causes.

THE report that the recent heavy rains in South Wales have led to large fissures appearing in the main road between Tirphil and Pontlottyn in the Rhymney Valley reminds us that a landslip occurred there on January 3rd, 1925, and carried away the down main line of the former Rhymney Railway, which fell into the valley. A goods train plunged into the gap and the driver and fireman were killed. The roadway passes under the lee of Troedrhiwfuwch Mountain, which has shown considerable signs of movement in recent years, and it is believed that the heavy rain of November has accentuated the trouble.

A VERY wise remark was made by Mr. J. H. Thomas when addressing a Railwaymen's Brotherhood meeting at Harlesden on Sunday, November 24th. Speaking of finding work for the unemployed, he said that the problem was so to organise affairs that those people might find permanent work in their own vocations. The railwaymen, he added, had vastly improved their positions since the day when the average wage of a railwayman was 24s. a week and many worked for 18s. or less. That improvement was not achieved by looking to the State or anyone else to help them, but by their own grit and determination.

THE proposal for a £6,000,000 road bridge over the Firth of Forth received a check when the Minister of Transport negatived the idea that the Government should pay the whole cost. The Forth Conservancy Board now suggests an express ferry. The Board says that it cannot give an accurate estimate of the volume of traffic, but there was good foundation for the belief that in a very short time the ferry would more than pay its way with charges not exceeding 2s. 6d. per car. It is suggested that a half-hourly service should be instituted and that it could be expedited to a twenty minutes' service at the rush hours. The total cost, including the necessary construction of piers and approaches, is estimated at £400,000.

ONE frequently hears and reads of the Garratt locomotive, but few know who Mr. A. W. Garratt was. He was a pupil of Mr. J. C. Park, of the North London Railway, and was afterwards on the London and South-Western. On the latter line his main duties were associated with the vacuum brake and his knowledge of that subject led to his being given charge of the equipment of the rolling stock on the Central Argentine Railway with the vacuum brake. Afterwards he supervised the gas lighting of the carriages. He subsequently became district locomotive superintendent of the Central Argentine, and before his death on September 25th, 1913, at the early age of forty-eight years, he had been the locomotive, carriage and wagon superintendent of three railways—the Cuban Central, Lagos and Lima.

THE Southern Railway is seeking powers to construct a very useful railway in the London area. It is to be known as the Motspur Park and Leatherhead line and will commence by a junction between the Raynes Park and Epsom branch, south of Blue Anchor crossing, and, passing through the parishes of Chessington and Ashtead, will run between the Epsom line and the Surbiton-Effingham Junction branch to Leatherhead. Thence there is access to Guildford *vid* Effingham Junction and to Dorking, Horsham and Portsmouth. Some years ago, after the grouping of the companies, we pointed out that stations on the Leatherhead line could be reached quicker *vid* Raynes Park than *vid* Sutton, and that route, moreover, avoided the severe reverse curve at Mitcham Junction and the heavily rising gradients into Sutton. The possibility of such a new route now being adopted would seem more promising were the proposed new railway sanctioned and built.

ACCORDING to the evidence given at the Ministry of Transport inquiry, opened by Colonel Trench on November 28th, into the fatal accident at Bath on November 20th, it appears possible that the derailment was due to a very unusual cause. The Somerset and Dorset Joint Line enters Bath by a steeply falling gradient, which, about 4 miles away, is approached by a short distance of 1 in 100 rising. On that length is Coombe Down Tunnel, just over a mile long, and the evidence showed that trouble had been experienced by enginemen owing to fumes in the tunnel. What happened on the occasion in question is not publicly known, as the driver was killed and the fireman and guard were unable to give evidence owing to their injuries. The signalman at Midford, which is the box on the other side of the tunnel, said that the deceased driver came to his box and said he had been having trouble with his engine. A shunter spoke of finding the driver's body with an overcoat over his head, and two witnesses gave evidence as to seeing no one on the footplate as the engine passed. The locomotive superintendent testified that the reversing gear was almost in full gear and locked and the regulator one-third open. A driver, who gave evidence as to some experiences he had going through the tunnel early in the present year, said that his theory was that, on the present occasion, the men were overcome by the fumes and did not know what happened. Colonel Trench adjourned his inquiry until the fireman and guard were well enough to attend.

Notes and Memoranda.

IN a paper read before the Royal Society of Arts on "The Examination of Coal and Coke by X-rays," Mr. C. N. Kemp gave hopes of the production of stereoscopic X-ray pictures of coal, with the object of demonstrating the distribution of the detritions within the mass of the coal itself.

AMONG the exhibits at the Barcelona Exhibition there is a working model of the blooming mill supplied by Davy Brothers, Ltd., of Sheffield, to the Sociedad Altos Hornos de Vizcaya of Bilbao. The model is on a scale of one-thirtieth full size, and was made by Messrs. Braun, of King's Cross.

A NOTE in the *South African Engineer* is indicative, although not very explicit, of the conditions of electricity supply in South Africa. It says that in Johannesburg the present tariff of 6d. per unit for 5 units per room, the excess units being charged at 1½d., is to be reduced, so that the "excess" units are to be charged at the rate of 1d., while it is contemplated that the excess charge will be ½d. before long.

AS a by-product in the smelting operations of the Burma Corporation, Ltd., at Namtu, in the Northern Shan States, there is now a regular production of nickel speiss, which in 1927 amounted to 1032 tons, containing 24·64 per cent. of nickel, 15·92 per cent. of copper, and 33–58 oz. of silver to the ton. The production in 1928 rose to 2933 tons, averaging 24·8 per cent. of nickel, 15·2 per cent. of copper, and 32·2 oz. of silver to the ton. The speiss is shipped to Hamburg for further treatment. It contains from 3 to 4 per cent. of cobalt.

THE summary of a report by Dr. A. L. Norbury to the British Cast Iron Research Association on the Measurement of Graphite Size in Cast Iron, reads as follows:—The terms "fine," "medium," and "coarse" graphite are not sufficiently explicit. The average length of the flakes in a representative area should be stated. It is difficult to measure the lengths of the flakes very accurately, as the flakes are often curved and join up, but approximately correct values may be obtained. The flakes may vary considerably in length in different parts of the same casting.

THE German inventor, Herr Max Valier, who was the originator of the "rocket" car and aeroplane idea, has recently made further trials at Duisburg with his "Rak 5," a car driven by what may be termed recoil action set up by the expulsion of compressed carbonic acid gas. The "Rak 5" consists of a low-built wood chassis, on which are mounted four metal gas containers. Pipes connected with these containers end in recoil chambers. A lever arrangement, operated by the driver's foot, controls the stream of gas. For the trials, the "Rak 5" was towed by an ordinary car until a speed of some 30 miles per hour was reached, and then uncoupled. Herr Valier then "carried on" with his stream of gas power, reaching, it is reported, speeds from 50 to 60 miles per hour over a considerable length of road.

THE aim of the South African Iron and Steel Institute will be, of course, to promote the use of native-made metal, and in this connection the *S.A. Mining and Engineering Journal* says:—One of the ways in which an outlet for primary products will be secured is through the promotion of a local industrial undertaking to make cast iron pipes, at the rate of some 20,000 tons per annum, malleable pipe fittings, hoop steel and iron, butt and lap-welded tubes and bolts, nuts and rivets. It is intended that this enterprise should work up certain special products for itself, such as puddled iron and certain grades of steel, and it will therefore be equipped with furnaces, a forge train and cogging mill, probably designed as one unit, in addition to a merchant mill for rolling the necessary range of strip and rods.

IN connection with the proposal of the London Power Company to wash its flue gases for the elimination of sulphur, the *Chemical Trade Journal* says:—"The whole question seems to have already resolved itself into one of disposing of the liquid effluent from the washing process. The ideal would be to have this liquid effluent just on the alkaline side and containing its sulphur wholly in the form of calcium sulphate, for the sulphite, although a neutral salt, may deplete the river water of oxygen in its subsequent oxidation to the sulphate. The present experiments have shown a rather surprisingly high oxdation of the sulphur dioxide of the flue gases during the absorption, and it is really the doubt as to whether this degree of oxidation can be maintained in large-scale working that has occasioned the attitude of hesitancy on the part of the Government Committee. There is, of course, always the alternative of the chemical oxidation of the liquid effluent before discharge into the river, but this may prove rather costly and difficult of control."

HERE are two cuttings taken contemporaneously from different sources, the one from Asia and the other from America. The two quotations raise the question as to the ultimate supercession of mechanical over natural processes. Canada, the journal of that name says, has the essential materials for a large artificial silk or rayon industry, and its growth holds out great possibilities, both in the enhancement in value of forest resources and in the development of an industry producing a highly manufactured product requiring skilled *personnel*. In her vast forest wealth is the raw material for the manufacture of cellulose, and in her great water powers lies the energy needed for the economical production of the cellulose and the important chemicals required in the manufacture of artificial silk. Great forest and water power resources in close proximity to centres of population taken together place Canada in an important position in the rayon producing field. On the other hand, the *Chinese Economic Bulletin*, an official organ of the Chinese Government, says, in connection with the natural silk business of China, which amounts to some £2,000,000 a year:—With the object of promoting the sale of silks and satins, the silk merchants of Huchow have been holding a fair in the centre of the city. Many booths and small pagodas have been erected, and flags, streamers, posters, and electric signs are to be seen everywhere. There are innumerable slogans, all to the same general effect. One reads: "If you do not use native goods, you are destroying the nation."

Miscellanea.

AN aerial passenger service is to be organised between Osaka and Shanghai.

THE leather footwear produced in Canada during 1928 amounted to 20,793,758 pairs.

AN aerodrome has been established at the Regina Asbestos Mine, Mashaba, Rhodesia.

WORK is being started on the quarrying of marble on the line of the Hudson Bay Railway.

PORT improvements to the extent of 1,000,000 dollars are being started at Halifax, Nova Scotia.

THE Mid-Lincolnshire Iron Company has begun operations on a new iron mine at Holton-le-Moor.

A BRIDGE is to be constructed across the Pearl River, southern China, between Canton and Honam Island.

THE first vessel to pass through the No. 1 lock of the New Welland Canal was sent upstream on November 1st.

AN overhead electric car service is to be organised in Japan between Katase and Enoshima, a distane of about 1 kilom.

TWO of the principal insulator manufacturing firms of Japan are installing plant capable of making tests at pressures up to 1 million volts. The apparatus is being made locally.

A HYDRO-ELECTRIC power plant of 25,000 horse-power is to be constructed on the Bogotan River in the Philippine Islands. The power is to be distributed by a 110,000-volt transmission line.

A PLANT for the extraction of oil from bituminous sand by a centrifugal process, on an extensive scale, has been set to work near Edmonton, Alberta. The sand is said to be left clean, white, and dry.

THE Spur Falls hydro-electric power plant is to be extended by the addition of 52,000 horse-power. This will bring the output of the Mohawk-Hudson system up to a total capacity of 550,000 horse-power.

IT is anticipated that the Bell Telephone Company of Canada will have to install a quarter of a million new telephones in the provinces of Ontario and Quebec during the next five years. The corresponding expenditure is put at 160 million dollars.

NEARLY 10,000 tons of foreign asphalt and bitumen, worth approximately £50,000, were imported into this country during October, according to the Board of Trade returns. During the past ten months 163,659 tons, valued at £801,062, were imported from abroad.

THE organisation that has in hand the question of a tunnel under the Scheldt has drawn up the specifications for the scheme which will be submitted to the contracting parties on December 15th. The latter will have a period of nine months in which to give their reply.

ARRANGEMENTS are being made for the construction of a concrete dam across the Lievre River, at Cedar Rapids, Quebec, to impound 25,000 million gallons of water. In connection therewith there will be a power-house of 120,000 horse-power, and a newsprint mill with a capacity of 250 tons a day.

WORK has been resumed on what, it is claimed, will be the world's largest sewage disposal plant, at Chicago. Work was suspended early this year on account of lack of funds, but the necessary appropriation has now been sanctioned. The final cost of this plant, which will serve a population of 1,800,000 people, is estimated at 54,600,000 dollars.

THE suspension bridge at Newport, Rhode Island, the construction of which had to be stopped on account of breakages in the wires of the cables early in April, as already described in THE ENGINEER, was opened for traffic, with new cables, on October 24th. In the interval practically the whole of the suspended structure had to be dismantled and reassembled.

A MESSAGE from Wellington, New Zealand, dated November 19th, states that Mr. H. P. Gibbs, a British hydro-electric engineer, representing a nitrogen-producing organisation which holds an option of a large power scheme at Lake Manapouri, near the fiords of the south-west coast, has returned to Dunedin after investigating the proposal on the spot. It is understood that the scheme involves the construction of 6 miles of tunnelling from Lake Manapouri to a deep cove, in order to obtain sufficient water to generate 250,000 H.P. The total cost of the scheme, it is understood, would amount to £6,000,000.

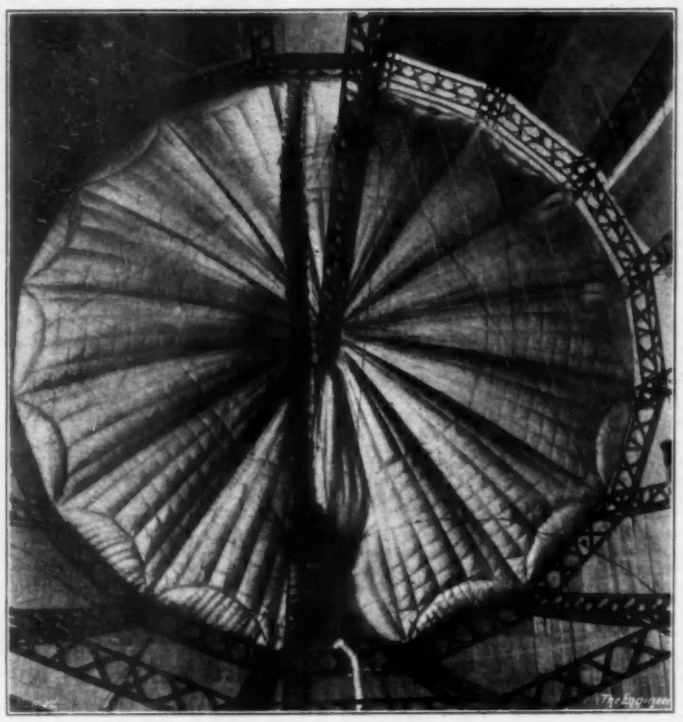
A SUCCESSFUL trial flight of the proposed extension of the Shanghai-Nanking air mail service to Hankow was made by Mr. Nieh Kai-yeh, Director of the Chinese Aviation Bureau of the Ministry of Communications, and two American aviators. The plane left the Hungjao aerodrome at 8 a.m. on October 9th and arrived at Nanking at 10.20 o'clock. After a brief stop it left Nanking and arrived at Hankow at 2.30 p.m. The actual flying time from Shangai to Hankow was 6½ hours. The authorities, however, are hoping that when the regular service is initiated, the distance will be covered in about 5 hours. It should be noted that the steamer service between Shanghai and Hankow takes at least 36 hours.

LECTURING on welding recently before the Junior Institution of Engineers, Mr. W. C. Freeman reviewed the advantages of the oxy-acetylene flame and the electric arc as the sources of heat in welding operations. He stated that up to about twenty-five years ago the only welding known was the fire weld, but the discovery of acetylene gas about that time brought autogenous welding rapidly to the front as the means of uniting steel, iron and other metals. One advantage of electrical spot welding over gas welding was its greater cheapness, it being stated that with current at 1d. per unit 1000 spots on 20-gauge steel would cost one penny. The welding of brass, which up to a few months ago had proved unsatisfactory, could now be accomplished by the acetylene blow-pipe if a brass flux was mixed with water and plastered on the underside of the piece to be welded and an excess of oxygen supplied to the flame, which then produced a perfectly clean and bright weld.

H. M. AIRSHIP R100

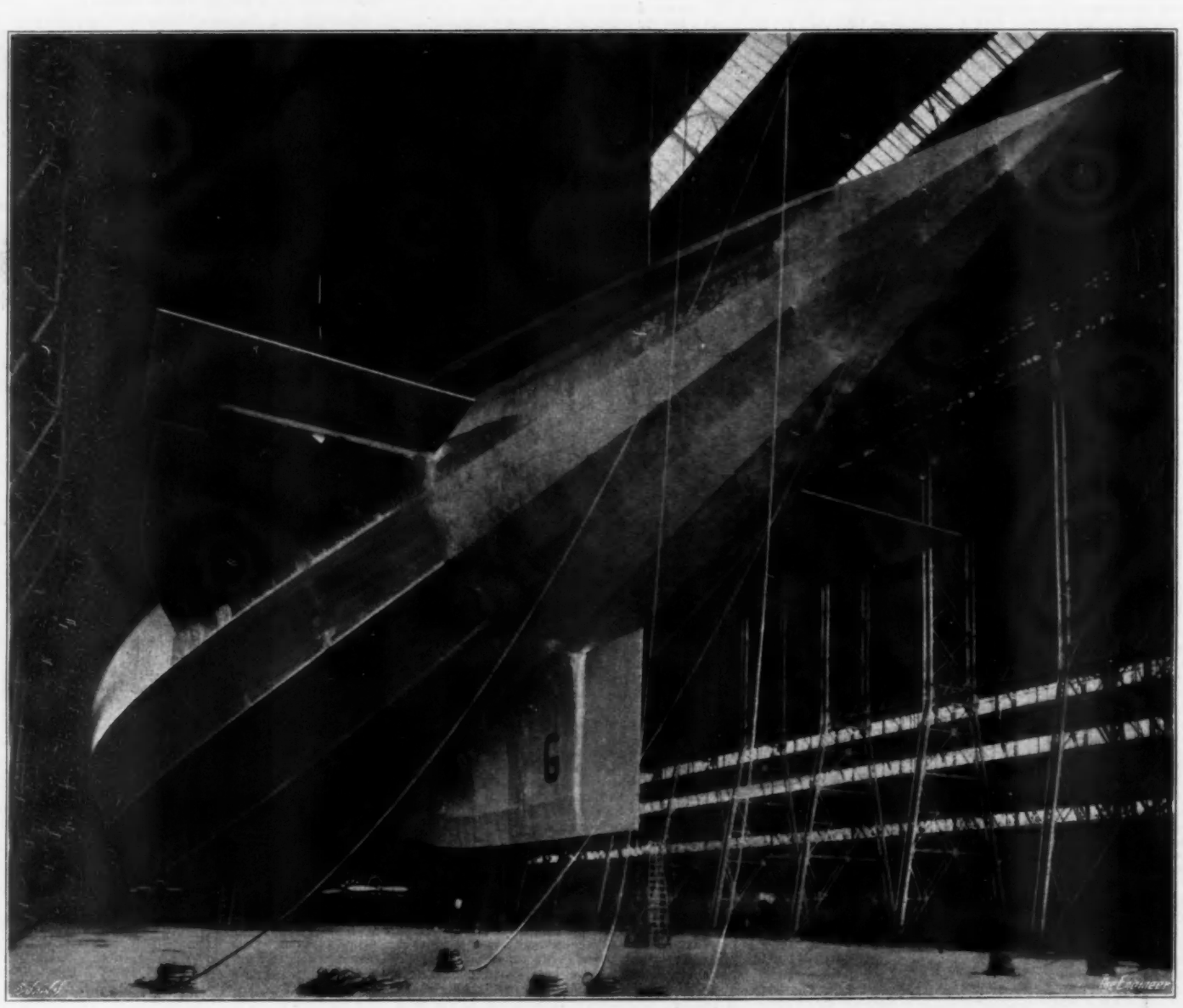
THE AIRSHIP GUARANTEE COMPANY, LTD., LONDON AND HOWDEN, BUILDERS

(*For description see page* 604).



ONE OF THE GAS BAGS INFLATED

TWIN-ENGINED POWER CAR



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DEATH.

ON December 3rd, in Glasgow, GEORGE STRACHAN, J.P., aged 70, Director of the Fairfield Shipbuilding and Engineering Company, Ltd.

THE ENGINEER.

DECEMBER 6, 1929.

The Agreement on Steam Tables.

THE International Steam Tables Conference which was held in London last July has not been long in justifying the hopes of its promoters. Until a few months ago the active investigations into the properties of steam which were being carried out independently in different countries appeared likely to result in the production of a number of conflicting steam tables, thus perpetuating the present nuisance as well as being a reproach to international science. Matters were drifting to such a conclusion when the Steam Tables Committee of the British Electrical and Allied Industries Research Association took the happy initiative of inviting the principal investigators to a round-table conference. The response was most encouraging. The list of the delegates who came to London showed how widespread was the desire to secure agreement, while the weight of their names gave a basis for hoping that something approaching finality was in sight. The ground to be covered was, however, controversial in the highest degree, and even though questions of personal pride and national prejudices might be assumed to be absent in a scientific gathering, there remained always the danger of the irreconciliability of different points of view. If, for example, one section had refused to accept any figures inconsistent with some physical or molecular theory in which it believed, while another had objected to any theory which did not appear to be borne out by somebody's empirical data, a deadlock might easily have been arrived at. But, fortunately, common sense ruled the Conference. The theorist lay down with the empiricist, each respectful for the susceptibilities of the other, and all parties devoted their energies to the practical work which lay to their hands, namely, the compilation of a steam table the figures of which could be accepted by all.

How they set about their task and the results so far achieved are shown in the report of the Conference reprinted on page 601 of this issue. Each figure given in the table was arrived at after consideration of the suggestions of the delegates of the four countries concerned, and was accepted by all the delegates, subject to an agreed margin of possible error. This method of procedure not only led to quick results, but entirely avoided the invidious duty of pronouncing for or against the work of any particular investigator. The idea of tabulating the properties of steam with a tolerance to allow for errors is a new one, but it is none the less appropriate to figures which, in the nature of things, can hardly be relied on to more than a certain number of decimal places. In existing steam tables, although no tolerance is stated, every engineer knows that absolute accuracy is unlikely. The new tables are thus more explicit than the old ones, for in place of the doubt as to the degree of faith that may be placed in any given figure, the reader is provided with limits between which the truth must certainly lie. As further knowledge accumulates, this margin of uncertainty will inevitably be reduced, and ultimately it should become a negligible quantity throughout the whole range of the tables. This desirable state of affairs will be further hastened by ensuring that the mean, or most probable value, of any figure is consistent with the most probable values given for all other figures thermodynamically connected with it, a check which the Conference has, admittedly, not yet applied. As they stand, the new agreed tables are much too skeleton-like to be useful for the daily work of the engineer. A little more work on the part of the Conference will remedy this defect, and with the narrowing of the limits of tolerance and the attainment of strict thermo-dynamic consistency, the new tables will provide a statement of the properties of steam accepted and used by the engineers of all countries. The work has been excellently begun, and we sincerely hope that it will be continued, without intermission, to its logical conclusion.

The production of the first international steam table, even in its present elementary form, raises acutely the question of the units in which the properties of steam shall be expressed. In all the English-speaking countries, the Fahrenheit scale of temperature still enjoys popular favour, though for scientific work it has long been discarded for the Centigrade scale. For calculations relating to steam the intolerable nuisance of a zero of temperature thirty-two degrees below the zero from which total heat and entropy are reckoned has induced very many engineers to abandon the Fahrenheit scale, and in standard works like Ewing's "Thermo-dynamics for Engineers," and Callendar's "Properties of Steam," the Centigrade scale is used exclusively. If the agreement on an international steam table leads to the agreement of all engineers to adopt an international way of expressing temperatures, much good will be done. But even so, this would only be a step towards that full comprehension of each other's units which is enjoyed by those engaged in electrical or chemical work in different countries. The wholesale adoption of the metric system of weights and measures is outside the range of practical politics, while, apart from the immense confusion and expense it would cause to manufacturers, no one has ever demonstrated that any economy would result. Experience shows that a designer or mechanic employing feet and pounds can do at least as much work in a day as one employing metres or kilogrammes, while he will make probably fewer errors. But when it comes to matters of pure calculation, amenable to logarithmic and slide-rule processes, a decimal division of units is highly convenient. Steam calculations fall into this class, and were metric units as familiar to all British steam engineers as the foot-pound units, there can be no question that they would be employed in computations, with the added advantage that the figures of one country would be intelligible in another. The unit of heat employed by continental engineers is the kilogram-calorie, defined as one-hundredth of the quantity of heat required to raise the temperature of a kilogramme of water from the freezing to the boiling point at atmospheric pressure. The desire to get away from the awkwardness of the Fahrenheit scale of temperature, while retaining the familiar British unit of mass, has resulted in the introduction of a cross-bred unit of heat—the pound-calorie—which is now largely used. Its equivalent in foot-pounds is 1400 exactly, a more convenient figure than the 778 foot-pounds corresponding to the B.Th.U. The very fact, however, that a heat unit must be expressible in work units involves the use of a conversion factor, such as Joule's equivalent, and any correction of this factor resulting from increasing knowledge upsets the relationship established. Engineers not

much past middle age will remember when 772 was taken as the value of Joule's equivalent. Then it was increased to the generally accepted figure of 778, until less than two years ago, when the American Bureau of Standards decided that 778·6 was a still more accurate value. But since heat is equivalent to work, it can be expressed in electrical as well as in mechanical units of work. Watt-seconds and kilowatt-hours have internationally accepted values, and by defining the heat unit in terms of the kilowatt-hour, the Conference has put it on the international footing so urgently required. Objections might be raised to the actual expression of heat quantities as fractions or multiples of a kilowatt-hour, on the grounds that such a nomenclature might be taken to imply the possibility of the complete conversion of heat into useful work. This difficulty has been overcome by the retention of the name kilo-calorie as a unit of heat, but defining it as the heat equivalent of $^1/_{860}$ kWh. The choice of this divisor was dictated by the desire to give the new heat unit as nearly as possible the same value as the existing kilo-calorie. It is much the same thing as if British engineers were to decide to alter the definition of the B.Th.U. to $^1/_{3412}$ kWh, to which it is almost exactly equivalent.

The new definition of the kilo-calorie marks a distinct step towards the rationalisation of units, and the Conference is to be congratulated on its decision. As regards the various conversion factors it has adopted, the only comment one can make is a regret that they are still necessary. The insistence by our engineering institutions upon a knowledge of foreign languages by candidates for examination shows a realisation of the advantage to an engineer of direct access to the technical literature of other countries. But this access is not complete unless the figures he comes across convey something to his mind without previous conversion to British units. It might be well, therefore, if a proportion of the questions relating to steam were set in international units, and were required to be worked out in these units. This would hasten the day when steam engineers, like their chemical and electrical colleagues, could all compute in a language which was universally understood.

Fumes from Power Stations.

ON Friday last, November 29th, we published an interim report on preliminary tests which have been made by the London Power Company to effect the removal of sulphurous fumes from the flue gases of power stations. On the same day the judgment of the House of Lords upon the Manchester case was published. The House dismissed the appeal of the Manchester Corporation from a decision of the Court of Appeal, and thus—for the time being—ended a case which has attracted interest for many months. The injunction against the Barton Power Station for nuisance is upheld, but the Corporation is given a year in which to prove either that it has "exhausted all reasonable modes of preventing mischief to the plaintiff" or that it has adopted the most "effective modes" of prevention. The Manchester Corporation Bill differs materially from the Electricity Commissioners' consent under which the London Power Company is constructing the Battersea Power Station. Under the latter the London Power Company undertakes to make every effort to prevent the emission of injurious gases; but there is no corresponding clause in the Manchester Bill, and the action was, therefore, one for "nuisance."

The judgment given by the Law Lords is of the greatest interest at the present time. We do not suppose for a single moment that the eminent judges were influenced in their decision in the least degree by the recent agitation against the Battersea Power Station. We have no doubt that they would have reached the same conclusions on legal grounds if that station had never been thought of. But we may opine that expressions used in their judgment would have been different had not the country been already aroused to a sense of the injury which may be done to treasured buildings, works of art, and parks by the emission of sulphurous fumes. We may, indeed, admit to a doubt that a few years ago a judge would have said of a similar case, as Lord Dunedin did last week in giving his judgment, "Its aspects bring up a question of the widest public importance, and it would be well indeed if it could be brought home, not merely to those interested in the development of the law, but to those who in the future are in the position which enables them to settle and control the position of great electrical stations." Or again, "I do hope this case may attract public attention, for assuredly the dangers it discloses are a matter of great importance to thousands of people." Such expressions as these reflect the feelings of all who have at heart the preservation and augmentation of the amenities and beauties of cities, and not less of those who believe that, under the necessary stimulation, engineers and scientists are capable of removing the objectionable features of their works. There will, we hope and believe, be general agreement with Lord Blanesburgh that in future a nuisance clause, or some other adequate protection for those who might be injuriously affected by the working of great power stations, should be inserted in Parliamentary Bills sought by electricity undertakers. We may even go further and hope that a clause similar to that which controls the London Power Company will be introduced into all Bills so that it may not even be necessary to sue for nuisance. We trust that in time poisonous gases will not alone come under this embargo, but that any and all forms of nuisance—noise amongst them—will be included. The report of the London Power Company's tests seem to indicate that sulphurous fumes can be removed, though we must admit that it is rather difficult to follow some of the figures given. Thus we find that, according to theory, 354 tons of water are required to remove completely all traces of sulphur produced by the combustion of a ton of coal with a content of 1·5 per cent. of sulphur. Yet it would appear that when a ton of Northumberland coal with 1·9 per cent. of sulphur was burnt at Grove-road, complete removal of SO_2 and SO_3 was effected with only 58 tons of water. That is a very remarkable difference, and in view of it we are not surprised by the statement of the Government chemists "that there are features in the experimental apparatus and process which are still obscure, so that, while we think there is no inherent reason why similar results should not be obtained from the larger experimental plant now being erected on the lines of a projected installation at Battersea, we prefer to await the results afforded by this larger experiment." But whatever the chemists may say, engineers are more concerned with practice than theory; if the theory does not agree with the practical results, so much the worse for the theory. The projected plant for Battersea consists of four towers, one standing at each end of two parallel rows of eight boilers. It is anticipated that only six boilers in each row will be needed at any one time, and each tower, therefore, will have to deal with the gases from three boilers. We understand that the washing water will be drawn from the circulating water after it has passed through the condensers, and that it will then be returned to the Thames, the alkalinity of which is sufficient to neutralise the acids which are formed by the absorption of the sulphurous gases. This is satisfactory, and in the interest of London we sincerely trust that the projected installation may prove completely effective. If so, it will solve the problem—in one way—for power stations on rivers, but it will still leave room for the ingenuity of chemical engineers to devise means for rendering cooling-tower stations equally innocuous.

The complete elimination of sulphurous fumes will remove one of the greatest objections to the erection of a power station at Battersea, but it will not make the existence of power stations in cities desirable, save perhaps on commercial grounds. Every power station must be in some degree a "nuisance" to the neighbourhood. With the best intentions, the best organisation, and the best equipment in the world, it will certainly at times—for all human things are frail—eject smoke and foul gases, and it must be continuously supplied with an immense volume of coal from which dust will inevitably escape. Whilst we all want to see our cities improved and their atmosphere clarified, we have still to tolerate many bad things because at present there is no means of getting rid of them. But we ought not to add to them in any degree. It is said that Battersea will improve the air of London by getting rid of some domestic coal fires. That remains to be seen; but in any case the same end could have been attained had the station been erected twenty miles away. The transmission of electricity has provided engineers with the means of effecting a great improvement of cities. We should be glad to see full advantage taken of it. The protest against Battersea has not merely been a protest against sulphur, but a witness of the increasing desire to preserve the beauties of our city in the face of a mechanical utilitarianism. It should, we suggest, be the continual object of engineers to provide the world with all those things which they alone are able to provide without robbing it of any of the graces and finer pleasures of life. That is a high but not an unattainable ideal.

Literature.

Vibration Problems in Engineering. By Professor S. TIMOSHENKO. London: Constable and Co., Ltd. Price 12s. 6d. net.

THIS is a book of 346 pages, divided into four chapters and one appendix. It is printed in the United States of America and its author is the Professor of Engineering Mechanics in the University of Michigan. The author ranges over the general subject of vibration, the principles of which are developed in Lord Rayleigh's "Sound," two volumes, but with this difference. Whilst Lord Rayleigh specifically limits the applications of the fundamental theory to those classes of vibrations producing audible sounds, the author develops and applies the fundamental theory to problems of the engineer. Engineers are indebted to Professor Timoshenko for so skilfully presenting and solving some of their most difficult problems.

It may be premised that the problems arise as a consequence of the yieldingness of matter. Nothing is perfectly rigid. A force applied to a structure or to a material always produces some displacement, some change of form. The change of form is often obvious and can be measured by gross means, as, for example, rubber. The change of form is invisible to the eye, but can be measured by delicate instruments, if the force is applied to such materials as steel or granite. But whether visible or invisible, a general relation between applied force and the change it produces was announced by Hook in 1678. Hook's Law, that change of form is proportional to the force producing it, that strain is proportional to stress, is known to every engineer. Although the law is not exactly true in any condition, yet it is so nearly true in most conditions for small displacements that it enters fundamentally into the mathematical analysis of vibration.

The application of a force to displace a system does work upon it. The system thus receives energy. When the force is removed, the system immediately starts to regain its undisturbed position, but arrives there carrying the energy with which the force has endowed it in the form of kinetic energy, and so it passes through its initial position and commences to vibrate about it. It is assumed that the force has not strained any part of the system beyond its limit of elasticity.

If the system were constructed of a perfect material and it were vibrating in a frictionless universe, it would go on vibrating for ever with an amplitude depending upon the initial displacement, because it could not get rid of its energy, wholly potential at the dead points of the vibration, wholly kinetic as it passes through its position of original rest.

No material is perfect; therefore some of the energy is lost in internal resistances, sometimes called hysteresis losses. Our world is far from frictionless, so that some of the energy is used up in overcoming the external and fluid frictional resistance to motion. Its motion is damped. Damping may be artificially increased, so that the energy is absorbed rapidly. Thus, the vibrating system is gradually brought to rest, each vibration having a smaller amplitude than its predecessor.

In general, therefore, every elastic system, if displaced and left to itself, will vibrate about its position of equilibrium with a definite frequency but with decreasing amplitude as the energy given to it by the forces displacing it is gradually dissipated against the damping resistances. The number of vibrations per second which the system makes in its endeavour to get to equilibrium again is the natural frequency of the free oscillation of the system. The actual number of vibrations which it makes before coming to rest depends upon the damping resistances. If these exceed a certain value the system does not make even one vibration; it comes to rest gradually on the mark, as it were; it is dead beat. Dead beat conditions are of importance to the engineer in many problems, and the mathematics relating to them is given in this book.

This free vibration may be interfered with by the continued application of force to the vibrating system. The applied force itself may, in fact, have a frequency of its own. Then each application meets the system in some phase of its free vibration to begin with, but after a time the frequency of the applied force prevails and forces the system to vibrate with a frequency equal to its own frequency. The system, however, still has power to determine the amplitude of the forced vibration.

If by some mischance the frequency of the applied force is equal to the natural frequency of the system, the amplitude of the forced oscillation would be infinite in the absence of damping. Damping alone limits the amplitude. As the applied force continues to give energy to the displaced system the damping forces must continue to dissipate it. When the rate at which the system receives energy is equal to the rate at which it dissipates it, the system continues to vibrate in a forced vibration of frequency equal to the applied force and an amplitude depending upon the damping resistances. The amplitude of the vibration may be small and insignificant—if the free and forced frequencies differ sufficiently—or it may be large and troublesome. In the neighbourhood of synchronism the amplitude is out of all proportion to the force producing it.

The author marshals principles and applications

of "Harmonic Vibrations Having One Degree of Freedom" in Chapter I. Harmonic means that Hook's law is assumed in the mathematical relations. One degree of freedom means that the displaced system can only v brate in one way. It cannot choose a variety of paths for its return to its position of rest after displacement. The usual equations which follow these assumptions for free, damped, and forced oscillations are developed and applied to such problems as the torsional and vertical oscillation of springs, the principles of design of vibrograph instruments for recording vibrations, the spring of the steam engine indicator, the effect of the locomotive balance weights on the track, vibration absorbers, dampers, and the critical speeds of rotating shafts. Special attention may be drawn to the author's clear exposition of Rayleigh's method in this chapter.

Chapter II.: the title is "Non-harmonic Vibration." The displacement is not assumed to be proportional to the force producing it. In Hook's law force plotted against displacement is a straight line. In this chapter the author begins with pseudoharmonic vibration. This type of vibration results when the force plotted against the displacement is a curve. Rubber, leather, concrete are materials which do not follow Hook's law except for very small displacement. Structures of materials of this kind, displaced, would execute pseudoharmonic vibrations about their positions of equilibrium. Free pseudoharmonic vibrations and forced pseudoharmonic vibrations are discussed and exemplified. When the displacement is a function of the time. the vibrations are called quasi-harmonic. Examples of this mode of vibration are, a pendulum whose length varies as the time, a cantilever whose flexural rigidities differ in different directions of the cross section, rotating with a weight hanging on its end as in a fatigue testing machine, and the coupling rod of an electrical locomotive. This last example is treated at length and is of great technical interest.

Systems having several degrees of freedom are investigated in Chapter III. Beginning with a simple example of Cartesian co-ordinates, the reader is soon led to the idea of defining the configuration of a system by generalised co-ordinates, a terminology, as the author states, which was introduced in Thomson and Tait's "Natural Philosophy" in 1867. The author goes on to show how the deflection curve of a beam may be represented by a trigonometrical series, the constants of each term being the generalised co-ordinates of the vibrating beam. This leads to the idea of generalised force and the beam example is continued to show that isolated loads acting on a beam may be represented by a trigonometrical series. The reader is then led to a peak of dynamic achievement, the Lagrange generalised equations of motion, first published in the *Mécanique Analytique*, Paris, 1788.

This powerful mathematical weapon is afterwards used to find the equations of motion in the many examples which follow in the rest of the book. These examples include the spherical pendulum, the free vibration of a stretched string loaded with three masses, the forced vibration of vehicles on their springs, the torsional vibration of geared systems. The torsional oscillation of crank shafts is a problem of peculiar interest to builders of internal combustion engines. The long crank shaft of a six-cylinder engine, with the heavy rotating masses attached to it and the heavy piston masses connected to it form a system of several degrees of freedom. The frequency corresponding to the fundamental mode of free torsional oscillation is within the region where it can synchronise with the forced oscillations caused by the regular impulsive actions applied to the shaft by the explosions in the cylinders. When synchronism is approached the results are troublesome. The engine will not govern properly, it is noisy, and in extreme conditions the crank shaft may be fractured by torsional oscillations of increasing amplitudes. It is fundamentally important, therefore, for designers to know how to calculate speeds of possible synchronism in the drawing-office. The author indicates how this can be done. The equations of motion for the shaft are found from the Lagrange generalised equations, the frequency equation is deduced and methods of solving it are discussed. An example of the calculations for a Diesel engine shaft is given.

Chapter IV. is devoted to the general treatment of the vibration of elastic bodies. The author in a footnote says that the most complete discussion of the vibration of elastic systems can be found in the famous book of Lord Rayleigh on "Sound." Nevertheless, the author manages to get into 126 pages matter covering the special field of interest to engineers. Longitudinal vibration of bars, torsional and lateral vibration of shafts, and forced vibration of beams lead to problems of more technical interest like the vibration of bridges, the vibration of turbine blades, the vibration of ships' hulls, vibration of turbine discs.

There is an appendix which describes instruments for measuring and recording vibrations which is full of interest because of the clear exposition of the principles on which the designs of the instruments are based.

The mere citation of the problems considered indicates that this is a book of outstanding importance. It must be read to understand the skill with which the author applies mathematics to the solution of these problems. Viewing it as a whole, it is one that every engineer should have on his shelves. The first chapter can be read by all who are moderately skilled in mathematics. The rest of the book requires deeper knowledge, but the author has used his own mathematical skill to smooth the way, and engineers will be grateful to him for bringing the dynamical machinery of Lagrange into the region of their own problems and showing them how to use it.

Disrupted Strata: Faulting and its Allied Problems from the Standpoint of the Mine Surveyor and Stratigraphist. By M. H. HADDOCK. London: Crosby Lockwood and Son. 1929. Price 16s.

ALTHOUGH this work is essentially mathematical in its treatment of the subject, it is perhaps to be regretted that the author shows too much fondness for advanced mathematical methods where simpler ones would answer the purpose and would probably be preferred by ninety-nine mining engineers out of a hundred. For example, he gives the well-known old method for obtaining the bearing and dip of the line of intersection of a fault and vein or other planes; this is usually the first stage in determining the direction in which a vein or bed is thrown by a fault, and for all practical purposes it is sufficient to employ ordinary geometrical methods. The author gives the ordinary geometrical method, though he fails to give it in its simplest form, and then proceeds to show how from this simple method a simple trigonometrical method can be deduced; he admits that the formula is well suited to ordinary logarithmic computation, but nevertheless proceeds to give what he looks upon as a more direct method involving spherical trigonometry, a subject with which few mining engineers are acquainted. Incidentally, the author's own simplification occupies considerably more space than the method involving only plane trigonometry.

The scope of the book is considerably wider than its title would indicate; for instance, one of the longest chapters is devoted to the location of planes by means of bore-holes; whether these planes are fault planes or any other planes the methods are obviously the same. Throughout the author deals with faults, beds, and seams as though they were invariably true geometrical planes, so that his work might well be described as a small treatise upon the intersections of true planes. Within these limits much useful matter may be found for anyone who has to solve such problems; it is to be feared, however, that the mining engineer who has to deal with veins, beds, and faults as they occur in Nature will but rarely be able to take advantage of the methods given in this book. The author himself appears to suspect that this is the case, because he himself states "that no particular rule will apply to all cases of faulting." This opinion will no doubt be endorsed by everyone who has had to deal with problems of faulting in actual practice.

We have noted in recent technical literature a regrettable tendency to use "data" as if it were in the singular number. The present author falls into that error. We need hardly say that data is the plural of datum, and it is properly used for a collection of observations or facts—as in the Data of Ethics. In spite of the fact that its meaning does not seem to have any obvious connection with datum, which to the engineer generally implies a point of reference, it is a plural noun and should therefore be used with verbs in the plural.

SHORT NOTICES.

Theory and Practice of Alternating Currents. Second edition. By A. T. Dover. London: Sir Isaac Pitman and Sons, Ltd. Price 18s.—This volume is devoted to general principles, circuits, polyphase systems, non-sinusoidal wave forms, the magnetisation of iron, instruments, measurements, and an elementary treatment of the initial conditions in the more simple electric circuits. In view of the fact that the author is of opinion that a thorough grounding in the principles of alternating current is essential before proceeding to the study of alternating-current machines, this portion of the subject has been treated on a broader basis than is the case in some text-books. Special features of the volume are an extended application of the circle or locus diagram to series, parallel, and series-parallel circuits; the reduction of the general circuit to its equivalent series-parallel form, and the development of a locus diagram therefor; the calculation of currents in unbalanced polyphase circuits, and the determination of the neutral point potential in the case of unbalanced, star-connected, three-phase circuits; the theory of the principal types of measuring instruments employed in alternating-current engineering, and a large number of worked examples in the text. The author has given considerable attention to the application of the inversion principle to cycle diagrams for the simple or fundamental circuit, as well as its application to the general circuit. In connection with the worked examples in the text, analytical, graphical and complex algebraic methods of solution have been employed. In some cases alternative methods of solution are given in order to show the student the steps involved in the application of the alternative methods.

Overhead Power Lines: Elementary Design and Calculations. By Captain W. Morecombe, R.E. London: Chapman and Hall, Ltd. Price 15s.—The objects of this book are to present certain constructional data for overhead lines in an easily interpreted form, and to explain the elementary features in the design that will prove helpful to the beginner. While the problems considered are mainly mechanical, the electrical features of alternating-current lines are briefly dealt with in the first chapter. Particular attention is paid to short-span construction on single wooden poles, which will satisfy most of the requirements met with in rural high-voltage and low-voltage distribution. As the book is concerned more particularly with short-span construction, some of the author's remarks may require modification in connection with long-span work, say, above 400ft.

BOOKS RECEIVED.

Egypt, Ministry of Public Works: Annual Report for 1924–25. Part II. Cairo: Government Press. 1929. Price P.T. 20.

The Principles and Practice of Lubrication. By A. W. Nash, M.Sc., and A. R. Bowen, M.Sc., Ph.D. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 15s. net.

Theory and Practice of Alternating Currents. Second edition. By A. J. Dover, M.I.E.E. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 18s. net.

A Concise Handbook of Provincial Local Government Law. By C. J. F. Atkinson. Revised by R. Borrogaard, M.A. London: Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 7s. 6d. net.

Obituary.

HARRY NOBLE.

As briefly announced in our last week's issue, the death of Mr. Harry Noble, the Chairman and Managing Director of Noble and Lund, Ltd., Machine Tool Makers, Felling-on-Tyne, took place at his home, The Cedars, Low Fell, Co. Durham, on Thursday, November 21st.

Mr. Noble served his apprenticeship with a firm of machine tool makers at Keighley, and subsequently accepted an appointment with Messrs. J. and F. Butterfield and Sons of that town, eventually reaching the position of Chief Draughtsman. On leaving Keighley he spent some time at the Central Marine Engine Works of Wm. Gray and Co., Ltd., of West Hartlepool, on special work.

In 1886 Mr. Noble moved to Newcastle-on-Tyne, and entered into partnership with Mr. Pearson Lund at Forth Banks as machine tool makers. Later the works were transferred to Felling-on-Tyne, and in 1899 the business was formed into a limited company, with Mr. Noble as Chairman and Managing Director.

In the early days the works were engaged chiefly in the manufacture of small lathes and band sawing machines, but as the result of Mr. Noble's progressive policy extensions were made from time to time, which enabled work of a much larger nature to be undertaken, so that machines weighing as much as 200 tons have been produced.

Mr. Noble was very well known in engineering circles, and was a member of the North-East Coast Institution of Engineers and Shipbuilders for forty years. During the war he was a member of the Tyne and Wear Board of Management under the Ministry of Munitions.

SIXTY YEARS AGO.

ALTHOUGH the Suez Canal was opened on November 17th, 1869, it was not until December 3rd that we were able to give our readers an account of the ceremony from the pen of a special correspondent whom we had dispatched to represent us at it. He was in passing the only representative of a British scientific journal present on the occasion. He witnessed the ceremony from the deck of the steamer "Fayoum," an ex-P. and O. paddle steamer of about 2000 tons, which had been acquired by the Khedive. In this vessel, lightened of all ballast to reduce her draught for the passage of the canal, he sailed from Alexandria on the 14th, and after an exceptionally rough trip arrived next day at Port Said. The inhabitants of Alexandria, he noted, expressed nothing but hostility to the canal, for they viewed very unfavourably the rise of a new port so close to their own. At Port Said he found the entrance harbour to be a fine sheet of water enclosed by two moles running for about 2000 yards out from the shore. He was doubtful however, about the future of the moles and harbour. The moles had been constructed of huge blocks formed from the local sand mixed with Marseilles lime. They had been tumbled anyhow into position in the hope that in time the drift of the sand would close the interstices. It had not done so at the time of his inspection, and he feared that the harbour would silt up unless constant dredging were resorted to. He sounded the entrance harbour after his arrival and found about 24ft. of water at most places. Ships of all nations except British crowded the harbour, dressed with flags by day and illuminated by night. Bands, broadsides and bombshells rent the air, and in the midst of the excitement two men-of-war ran aground when endeavouring to enter the harbour. Then came rumours that a vessel, the "Latif," had gone aground anything from 7 to 20 miles up the canal, and that the passage way had been blocked. Under the superintendence of the Khedive himself, however, and with resort to a strenuous night of work, the vessel was refloated in time for the formal opening next day. At 2 p.m. on the 17th the "Fayoum," with our correspondent on board, entered the canal at Port Said, the thirty-second of the line of ships forming the procession. Six of the vessels ahead ran aground, and at 7 p.m. the "Fayoum" herself struck the bank and threatened to swing across the canal. Eventually Ismailia was reached, and from there our correspondent sent off his dispatch. Sounding the canal so far as he had gone, he found frequently depths of 24ft. or more instead of the 18ft. which rumour had prognosticated. The banks gave him cause for anxiety. They were, he said, much too steeply sloped, and the wash from the "Fayoum," even although her speed was only from 4 to 7 knots, visibly brought down a trail of sand and pebbles into the water.

Public Works, Roads and Transport Exhibition.

No. III. (*conclusion*).*

The Lead Wool Company, Ltd.

In addition to numerous samples of the "Lead Wool" from which it takes its name, the Lead Wool Company, Ltd., of Snodland, Kent, showed several types of air compressors, including some small machines intended for garage work and for paint spraying. The larger portable air compressor which is illustrated in Fig. 28 was exhibited for the first time. This compressor is driven by a four-cylinder Dorman type 4 J.U.D. water-cooled petrol engine, which has cylinders of 95 mm. bore and 140 mm. stroke and is designed to develop 27 B.H.P. at a speed of 1000 r.p.m. It has a B.T.H. high-tension magneto and a Zenith carburetter with air filter and shutter. The air compressor has two cylinders, each with a bore of 135 mm. and a stroke of 110 mm. The

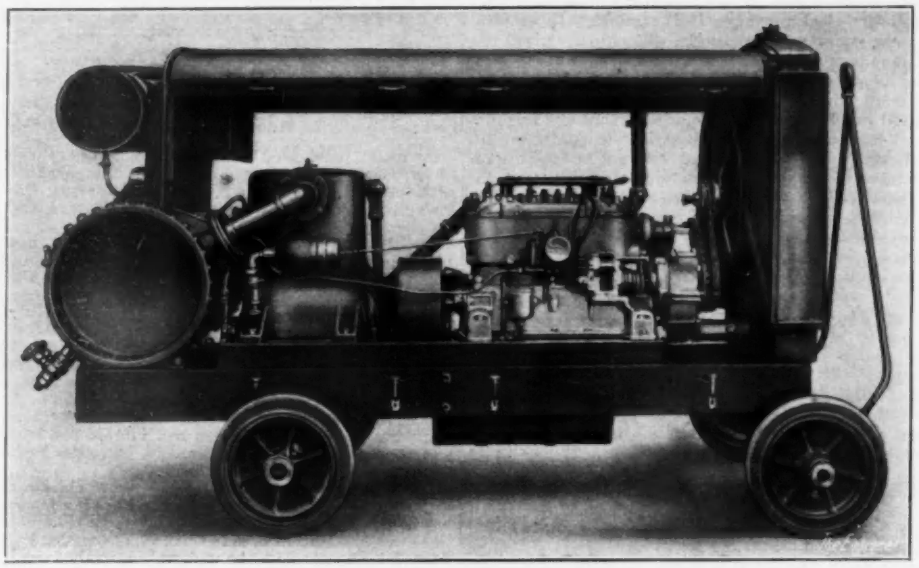


FIG. 28—PORTABLE AIR COMPRESSOR—LEAD WOOL COMPANY

cylinders, which are water jacketed, are cast *en bloc* and there is a screwed valve cover to give access to the piston heads and discharge valves for de-carbonisation. The crank shaft is in two pieces and roller and ball bearings are applied to both the main and the connecting-rod bearings. Lubrication is effected by means of geared pumps, no external lubricators being employed. There is an automatic unloader which closes the throttle of the engine when the air pressure rises to the desired pressure and is not being used. The water for both engine and compressor cylinders is circulated through the radiator by a pump. The air receiver, which is tested hydraulically to a pressure of 250 lb. per square inch, is furnished with a relief valve and pressure gauge, and, as standard, with five air cocks, though more can be fitted if required. The compressor is driven direct from the engine without

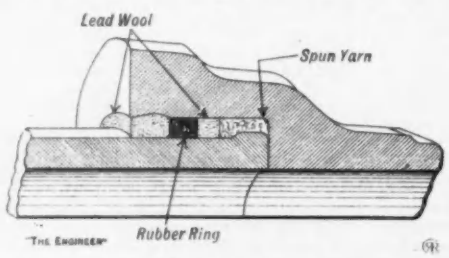


FIG. 29—PIPE JOINT—LEAD WOOL COMPANY

speed reduction and the piston displacement is 111 cubic feet of free air per minute at 1000 r.p.m. The whole of the equipment is mounted on an under-carriage, which is built up of steel channels, and the road wheels are of wrought iron. The total weight is approximately 25 cwt.

The company was also exhibiting a new type of pipe joint which it has recently introduced and patented. It is illustrated in Fig. 29. The makers point out that this joint should be of special interest to engineers who are concerned with distributing gas under pressure, as it is a combination joint designed to withstand high-pressure gas and excessive vibration. As will be seen in the illustration, the innovation consists in the insertion of a rubber ring between other caulking materials. The method of making the joint is as follow :—Spun yarn is first of all caulked at the back in the usual way. A collar of "Lead Wool," ¾in. in depth, is then put in and caulked after which a rubber ring is inserted, and finally a further serving of "Lead Wool" is caulked on the top of the ring. The rubber ring, which is tight on the spigot, is slightly bigger than the joint space, and is, furthermore, compressed between the collars of "Lead Wool." It is stated that this joint has been tested to a pressure of 100 lb. of air without showing any leakage and that it has proved satisfactory in such places as bridge crossings subjected to severe vibration and springing.

* No. II. appeared November 29th.

Barford and Perkins, Ltd.

Three novelties, amongst other exhibits, were on the attractive stand of Barford and Perkins, Ltd., of Peterborough, but as the company does not, at the moment, desire full descriptions to be published, we are not permitted to say much about them in the present instance. One of them was a 1-ton motor roller, specially intended for use on sports grounds, which has been modified from a previous model so as, in effect, to make an entirely new machine of it. Another was a roller, the rear wheels of which are fitted with a spring-controlled cambering device which is so designed that the two wheels can camber independently. The third was an entirely new type of motor road roller, known as type "T.J.D.," which has three wheels and weighs, in working order without water ballast, 11½ tons, approximately. Some 2½ tons of water ballast can be carried. The back rollers are 5ft. 6in. in diameter and 17in. wide, the front roller having a diameter of 4ft. and a width of 4ft. 2in. The motive power is derived from a high-speed twin-cylinder solid-injection engine running on crude oil. There are two brakes, and braking and steering are effected by concentric hand wheels, one being carried by a central spindle, the other being mounted on a tube which embraces the spindle. The steering is done either by hand or by power. Two reverse clutches are incorporated in a new design of gear-box which gives three speeds forward and a reverse. There is a pulley on the crank shaft for driving machinery. The fuel tank has a capacity of 30 gallons, and there is a sprinkling water tank which can hold 120 gallons and which is furnished with pipes leading to both front and back wheels.

International Combustion, Ltd.

International Combustion, Ltd., of 11, Southampton-row, London, W.C. 1, showed what is known as the "Ro-Tap" testing-sieve shaker. This apparatus, which is an American invention, has not hitherto been exhibited in this country. It is designed to reproduce the circular and tapping motions that are given to testing sieves in hand sieving, but with a uniform, mechanical action, which produces dependable sizing tests. With it, it is claimed, there is economy, not only in a big saving of time and labour, and in the longer "life" of the testing sieves, but there is also a saving by eliminating errors in testing, which might have resulted in heavy losses. From one to thirteen sieves can be shaken at one operation by the "Ro-Tap" apparatus, which is operated by a small electric motor. With regular-height sieves, one sample can be tested on a series of six sieves of different mesh, while with half-height sieves, one sample can be analysed on a series of thirteen sieves at one operation. By using pans with extended rims three different samples can be tested at one time with regular-height sieves, and seven different samples with half-height sieves.

The Atlas Diesel Company, Ltd.

The Atlas Diesel Company, Ltd., of New Oxford House, Hart-street, London, W.C. 1, had an extensive exhibit comprising, mainly, pneumatic machinery and tools specially designed for the use of public works contractors. There were, for example, two petrol-driven portable air compressors, one for 114 and the other for 127 cubic feet of free air per minute compressed to 100 lb. per square inch. Then there were a stationary air compressor with a capacity of 64 cubic feet per minute arranged for belt driving, and a small crude oil engine designed to give 9 B.H.P. at 750 r.p.m. There were, in addition, several stone breakers, and a large number of different kinds of pneumatic tools and machines, including pick hammers, diggers, rammers, tampers, pile drivers, drills, caulkers, &c., and a pneumatic hoist.

Holman Brothers, Ltd.

Holman Brothers, Ltd., of Camborne, exhibited all sorts of machines and tools for repairing roads, &c. Among their latest introductions is what they term their "Road Ripper," a view of which in operation is given in Fig. 30. This pneumatic tool may be fitted with a silencer, and is so shown in the illustration. The silencer, to which the name "Hush Buster" has been applied, is designed to help to solve the street noise problem, and it is said to reduce the noise made by a road breaking drill by 60 per cent. The device consists of forming the exhaust of a pipe of fairly large diameter, arranged zigzag fashion so as to make it as long as possible. The tool was not shown in operation—at any rate during our visits to the Exhibition—so that we were unable ourselves to judge of the amount of silencing obtained by it; but it is on the report of an independent expert that the claim of 60 per cent. reduction in the noise is made.

Another interesting exhibit shown by this firm was the Hele-Shaw Beacham portable air compressor, which is illustrated in Fig. 31. The plant is arranged on a carriage built up of steel channels and cast steel

FIG. 30—SILENCED "ROAD RIPPER"—HOLMAN

cross pieces, and mounted on semi-elliptic springs and a pair of Dunlop pneumatic tired wheels 32in. in diameter. The set is intended for being hauled by a motor car or other sort of tractor, and we understand that, with the mounting illustrated, it has been drawn by a 12 H.P. touring car at 40 miles per hour, and that average speeds of more than 20 m.p.h. have been maintained over long distances. A telescopic jack is arranged at each corner to take the weight of the set and to keep it horizontal when it is working.

The compressor unit consists of three cylinders—each with a bore of 6½in.—formed in one casting, which, mounted on ball and roller bearings, rotates about a fixed water-cooled central valve. The pistons are carried by roller bearings which are guided by floating rings. The centre of these floating rings is excentric to that of the valve and cylinder body, and a reciprocating motion is, therefore, imparted to the pistons when the cylinder body is rotated, the stroke of the pistons being 1⅞in. The whole is enclosed in a water-jacketed casing.

The same cycle of air suction, compression and delivery takes place as in an ordinary reciprocating compressor with mechanically-operated valves. There is, however, no valve-operating mechanism, the admission of air, cut-off and discharge being controlled by the port in each cylinder end automatically opening and closing the ports in the valve communicating with the inlet and discharge passages in the central valve. A non-return valve is arranged between the compressor and receiver.

An air filter and a control valve are fitted to the inlet of the compressor. The latter closes the suction when the pressure in the receiver reaches a pre-

determined limit, and any air which might leak into the compressor is discharged to atmosphere. The same pilot valve which controls the unloading of the compressor also controls the engine throttle, and the speed is reduced during unloaded periods. The makers point out that the design of the compressor is such that it may be run efficiently and without vibration at high speeds. The normal speed of the set illustrated is 1500 r.p.m

The compressor is driven direct by a Dorman four-cylinder four-cycle petrol engine, which at 1500 r.p.m. is capable of developing about 43 H.P., or far in excess of the power required by the compressor, so that there is an ample margin of reserve. A centrifugal governor maintains a constant speed when under load and, in order to save petrol, the automatic throttle control, previously mentioned, comes into operation when the compressor is unloaded. Between the engine and compressor there is a plate-type hand-operated friction clutch. There is one cooling system for both engine and compressor, an engine-driven pump circulating the water from the radiator first to the compressor then to the engine and back to the radiator. The radiator fan is driven by belt from the engine, adjustment being provided to take up belt slack.

The air receiver is of 8 cubic feet capacity and is fitted with a safety valve, pressure gauge, a drain cock and a delivery manifold with connections for four machines. The net weight of the plant is given as being about 2800 lb. The overall length—without draw-bar—is 8ft., the height being 5ft. 6in., and the wheel track 4ft. 1in. The normal working pressure is 80 lb. per square inch, but the makers inform us that the plant is quite capable of compressing air to 100 lb. per square inch.

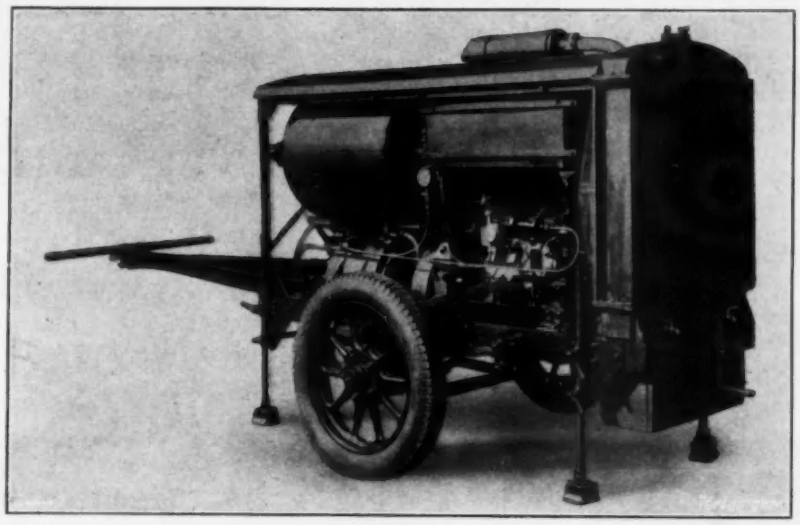


FIG. 31—PORTABLE AIR COMPRESSOR—HOLMAN

REAVELL AND CO., LTD.

Three sizes of portable air compressor sets driven by petrol engines, among numerous other things, were exhibited on the stand of Reavell and Co., Ltd., of Ipswich. Their capacities were 74, 118 and 153 cubic feet of free air per minute. The two smaller machines had vertical single-acting compressors, while the largest machine embodied a compressor of the quadruplex type. Although the vehicle fitted with the middle-sized machine has now been on the market for some little time, it was exhibited at Islington for the first time. It is illustrated in the drawing, Fig. 32. It is, as will be seen, mounted on a motor lorry chassis. The chassis was built by Dennis Bros., Ltd., of Guildford, and we gather that that firm has supplied several similar sets to a London gas company. The equipment was particularly designed for gas main repair work, in which, in order to make good a leaking main in the least possible time, it is of the utmost importance that the compressor should be transported to the scene of the trouble without any delay. The ordinary portable compressor, which has to be hauled along, being unsuitable, it was decided to mount the compressor on a lorry. The compressor, which is known as Size DSA 6, is driven direct from the lorry engine through totally enclosed gearing running in oil. It has two cylinders, 6in. in diameter by 4½in. stroke, and it has a capacity of 118 cubic feet of free air per minute compressed to a pressure of 100 lb. per square inch at a speed of 800 revolutions per minute, under which conditions it requires 21 B.H.P. to d ive it. The cylinders and their heads are water-jacketed. The valves are of the low-lift light plate type. The valve pockets, which are in the removable cylinder head, are, with it, water-jacketed. Lubrication is on the automatic or controlled-splash system, throwers being provided on the connecting rods to create a mist of oil, which may lubricate all the working parts. Scraper rings are fitted to the pistons to prevent an excessive quantity of oil from entering the cylinders. A separate radiator cools the compressor cooling water, and the set is furnished with an unloading device and an air receiver.

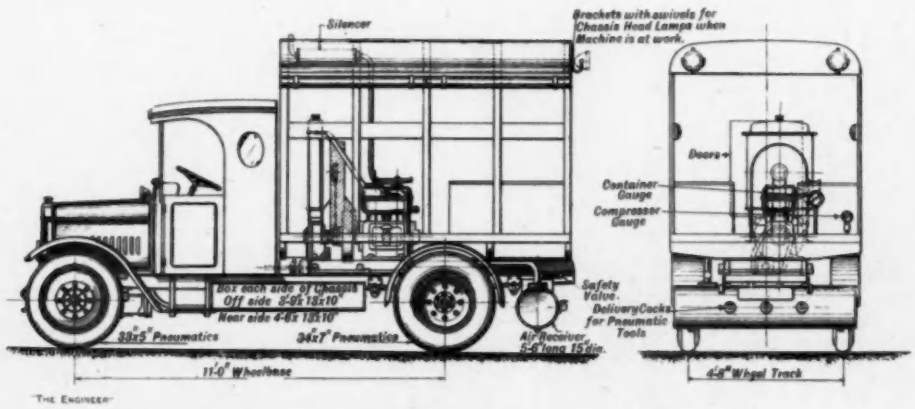


FIG. 32—AIR COMPRESSOR ON LORRY CHASSIS—REAVELL

SAMUEL PEGG AND SON.

In addition to other exhibits, three new things were shown by Samuel Pegg and Son, of Leicester. They were, first, what the firm terms its "Samson" 300 granulator, then a vibratory screen, and, finally, a power tamper.

The new granulator, which is shown in Fig. 33, is a recent development of the granulator formerly made by this firm. The bearings have been completely re-designed, and are now set at an angle to the frame, so that the main thrust of the shaft is taken on the centre of the bearing instead of at the joint between the two halves of the bearing shells, as had been standard practice for many years. The bearings themselves have also been made considerably larger. The body, too, has been made deeper, experiments having proved that not only is the cubular quality of the stone produced improved by making the body deeper, but also that the output is increased thereby. All parts subject to wear are of manganese steel, while in the larger sizes of granulators the jawstock is made of toughened cast steel. The body, in all sizes, is a heavy semi-steel casting. Lubrication is effected by sight-feed grease gun fed lubricators.

The new vibratory screen is illustrated in Fig. 34. It has been designed to meet the demand for a more effective screening medium than is provided by the rotary type of screen, which, say Messrs. Pegg, excellent though it is in the larger sizes, "fails to give that uniform grading and efficiency demanded by present-day stringent requirements." The screen

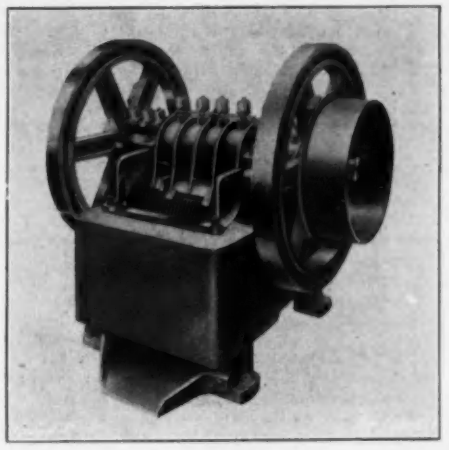


FIG. 33—"SAMSON" GRANULATOR—PEGG

is operated through two out-of-balance weights, which are mounted on a shaft that rotates at 1800 r.p.m. This shaft transmits vibrations to the screen frame, and, in turn, to the screen cloth, which is rigidly tensioned in the screen frame. It runs in self-aligning ball bearings, which are equipped with a labyrinth seal to exclude dust. The screen is supported at the top and bottom on full elliptic springs. This two-point suspension is claimed to ensure that the heavy vibratory motion set up by the shaft is

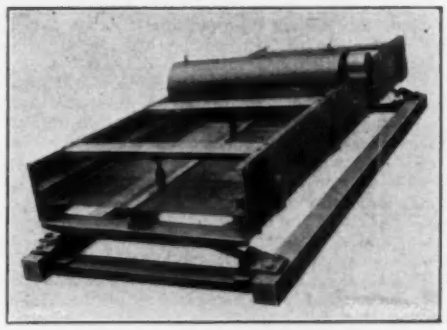


FIG. 34—VIBRATORY SCREEN—PEGG

distributed in equal intensity over the whole of the screening area. We understand that wet or dry stone, gravel, slag, coke, and similar materials can be accurately graded in sizes ranging from 2½in. down to 100 mesh, and that maximum capacity can be obtained whether the material is wet or dry. In point of fact, we are informed that the use of a spray pipe over the screen increases, very considerably, the output on gravel, &c.

The screen cloth can be changed in ten minutes.

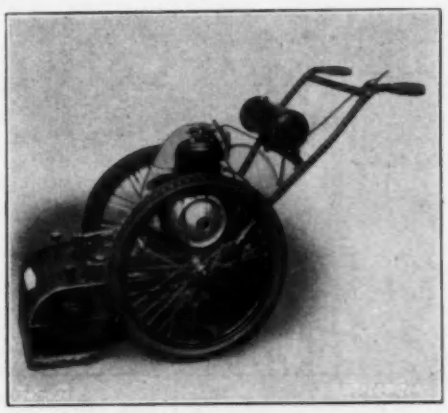


FIG. 35—POWER TAMPER—PEGG

It measures 3ft. wide by 8ft. long, a size which Messrs. Pegg say that they find meets practically all requirements and permits of the attainment of the highest degree of screening efficiency. The capacity is from 15 to 18 tons per hour, according to the material being dealt with. The screen can be equipped with one, two or three decks.

The Power Tamper, illustrated in Fig. 35, has been designed, primarily, for the more effective con-

solidation of tar and bituminous macadam, more especially in road roller work, for patching, and for use in places where it is impossible or inadvisable to use a road roller. It is also intended for minor operations for which the cost of transport of a road roller over great distances would be prohibitive. Among the claims made for it are that it is essentially transportable, that it can be manipulated by comparatively unskilled labour, and that the cost of running it is negligible.

The machine embodies one or more tamping plates, on which are mounted geared shafts operating off-centre weights. These shafts are driven by a 3½ H.P. petrol engine, and deliver from 600 to 1000 blows per minute. The tamper plate is suspended from the frame by means of semi-elliptic springs, the springs being held with shackle alignment. The frame is built up of steel pressings and the whole machine is carried on two wheels equipped with Timken bearings.

AVELING AND PORTER, LTD.

Two new types of road roller, one of them driven by a compound steam engine, the other having a crude oil engine, were to be seen on the stand of Aveling and Porter, Ltd., of Rochester.

The new steam roller has been evolved to provide a greater power reserve and steaming capacity than was possessed by the rollers previously built by this firm. The boiler is larger and it has no stays in the crown, the fire-box top being corrugated to give the strength sacrificed by their omission. There is, also, additional heating surface at the most effective point. The tender, too, is larger and is strong enough to take a scarifier without additional bracing. A two-tine scarifier was, in fact, attached to the roller at the Exhibition. The steering gear is enclosed and is attached by a novel arrangement to the boiler barrel. Many additional improvements in detail have, we are given to understand, also been made. For instance, the feed pump is gear driven and can be disengaged when the pump is not required. The weight in working order is 11 tons 10 cwt.

The oil-driven roller was a considerably heavier machine, weighing some 16 tons in working order. It is operated by a slow-running, single-cylinder, heavy-oil engine of the Blackstone patented "spring-injection" type, with certain modifications. The speed of this engine is, approximately, the same as that of a steam engine driving a roller of similar weight. Self-aligning bearings are fitted to the engine crank shaft and to the main transmission shafts, so as to reduce friction as much as possible. The worm and quadrant steering gear, which is of an improved type, is operated through cut bevels, and incorporates a shock-absorbing device, while the thrust on the upright and worm shaft is taken by special ball races. Grease gun lubrication is provided for the principal moving parts of the chassis.

A couple of concrete mixers, one of them of 5½/3½ cubic feet capacity without a loading hopper and the other a 10/7 cubic feet capacity machine, fitted with a power-operated loading hopper, also formed part of this firm's exhibit. The larger machine was shown in operation.

KERR, STUART AND CO., LTD.

Kerr, Stuart and Co., Ltd., of Stoke-on-Trent, exhibited the chassis of what they term their 7-ton Diesel lorry. It is illustrated in Fig. 36, and it

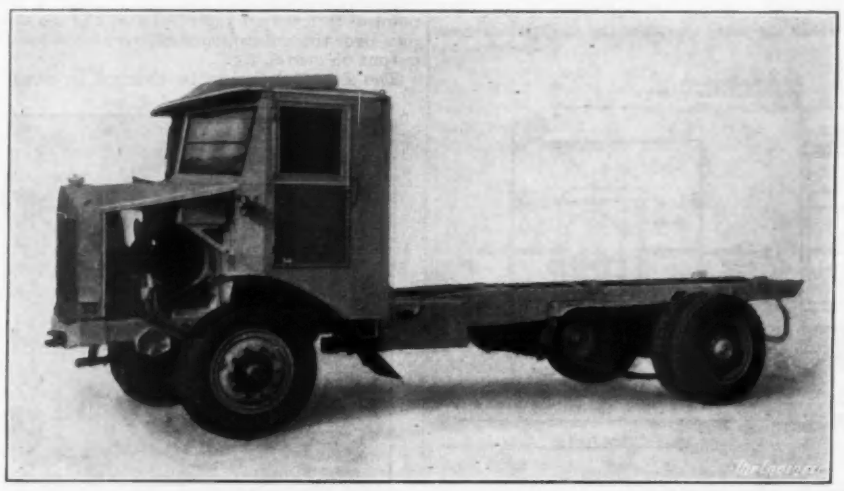


FIG. 36—7-TON HEAVY-OIL ENGINE LORRY—KERR, STUART

possesses a number of most interesting features, while many claims for it are made by its makers. It may be said at the outset that the workmanship throughout appeared to us to be excellent. The engine, which is of the airless injection type, has four cylinders, each with a bore of 135 mm. and a stroke of 200 mm., and it is designed to develop 70 B.H.P. at 800 r.p.m. The cylinders, which are detachable, are fitted with renewable cast iron liners, and are water-jacketed, the jacket completely surrounding both the inlet and the exhaust valves. The valve gear, which is protected by covers to keep out the dust, is operated from a camshaft running in the top of the crank case by push-rods and overhead rocker arms. The mechanism by which the oil is supplied to the cylinders forms a separate assembly of its own. It embodies four separate small pumps, one for each cylinder, to which it is connected by a small-bore copper pipe. Inside the pump assembly is a camshaft with four cams one of which operates each pump. It also contains a centrifugal governor, which varies the strokes of all four pumps together, in sympathy with the speed of the engine. This governor is arranged positively to prevent the engine exceeding its designed speed of about 800 revolutions per minute, but its action can, we understand, be varied so as to lower the speed down to about 150 revolutions per minute, by foot pedal controlled by the driver. The atomisers, which are of the spring-closed type, are fitted in the heads of the cylinders and spray into a pre-chamber. Each atomiser is furnished with a hand-operated

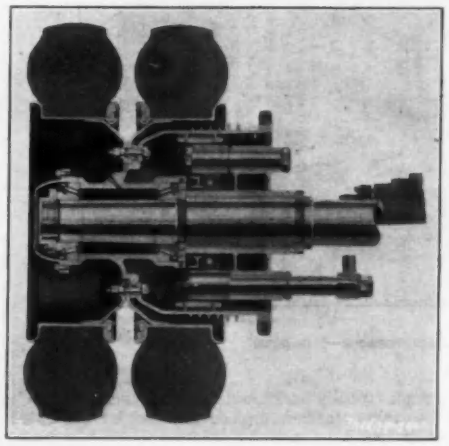


FIG. 37—REAR AXLE OF LORRY—KERR, STUART

by-pass and tell-tale, so that the operation of the pumps can be seen at any time. The compression ratio employed is 14 to 1. The water circulation is effected by means of an impeller carried on the end of the fan spindle inside the casing of the forward cylinder.

Power is transmitted from the engine first through a reverse-cone, Ferodo-faced clutch, which is operated by foot pedal, and thence to a gear-box through a short propeller shaft provided with Hardy-Spicer fabric joints at either end. The gear-box furnishes four forward speeds and a reverse, the standard overall ratios being: Top, 4·4 to 1; third, 7·94 to 1; second, 14·78 to 1, and bottom, 29·35 to 1, the reverse ratio being 27·8 to 1. With the engine running at 800 r.p.m., top gear gives a travelling speed of 20 miles per hour; third gear, 11·1 m.p.h.; second gear, 6 m.p.h., and bottom, 3 m.p.h., the reverse speed being 3·16 m.p.h. The top gear is direct, the final reduction being by means of a steel worm and a phosphor bronze worm wheel. The differential is carried in the centre of the worm wheel and is lubricated from the gear-box, which, itself, is totally enclosed and self-lubricating, and has an accessible filler which is so arranged that the gear-box cannot be over-filled.

The final transmission is by silent roller chains, with a 2½in. pitch, from a sprocket at each side of the gear-box, to a chain ring on the brake drum of each back wheel. The chains, the makers inform us, are much stronger than is absolutely necessary, and, since the bulk of the reduction takes place in the gear-box, the sprockets are large, being given twenty teeth. The rear axle, which is illustrated in Fig. 37, is a high duty nickel steel tube. It does not revolve, and carries the dead weight of the vehicle only. The front axle—Fig. 38—is a drop forging. All the hubs are fitted with taper roller bearings. The front springs are semi-elliptical, pinned at the forward ends, and carried on slippers at the rear. At the rear axle there are two semi-elliptical springs carried athwartwise on a cross member of the chassis and bearing at both ends on pads on the brake housings. Steering is on the Marles system.

The vehicle has a platform length of over 15ft. and a width of 6ft. 6½in. inside the chock rails, the loading height being 3ft. 9½in., while the wheel base is 13ft. 6in. and the overhang 5ft. 3in. The track of the front wheels is 6ft. 2in. and that of the rear wheels 5ft. 8½in. The turning circle, both right and left hand, is given as being 56ft. in diameter. The length overall is 22ft. 3in. and the overall width

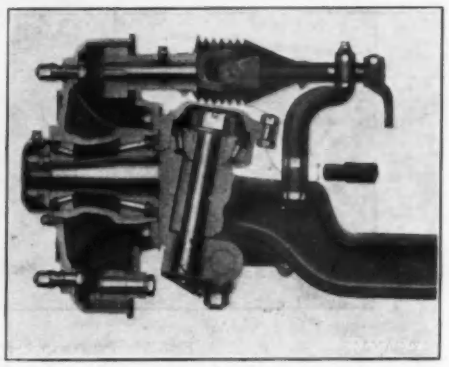


FIG. 38—FRONT AXLE OF LORRY—KERR, STUART

7ft. 6in. We understand that a gallon of fuel oil will give from 10 to 14 car-miles, according to load, and that 1½ gallons of lubricating oil are sufficient for a week's work, representing between 600 and 700 miles.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, LTD.

The Wellman Smith Owen Engineering Corporation, Ltd., of Victoria Station House, London, S.W. 1, showed, by means of a cinematograph film, the operation of a new type of combined excavator and crane, on the production of which it is now engaged and which is known as the Wellman-Denholm ½ cubic yard Universal excavator. This excavator, which is claimed to be the only one of its type to be built in this country, is designed to fulfil seven separate functions, the equipment for which was exhibited on the company's stand. These functions are as follows:—(*a*) Dipper or shovel, ½ cubic yard, for side hill and mass digging; (*b*) skinner, ½ cubic yard, for levelling and road excavation; (*c*) trencher, for trench digging to a depth of 14ft. 6in., and any width from 16in. to 12ft., and also for foundation digging and general below-ground excavating; (*d*) dragline, ½ cubic yard, for below-ground excavating; (*e*) grab, ½ cubic yard, for the loading and unloading of stock piles, trucks, lorries, &c., and light excavating; (*f*) crane for general lifting duties; (*g*) backfiller. Three types are made for backfilling trenches, including a drag blade with a 25ft. boom, a push-blade for use with a trencher boom, and a blade for attachment to a trencher bucket.

HADFIELDS, LTD.

Hadfields, Ltd., showed a combination machine embodying one of its 16in. by 9½in. stone breakers, with a screen and feeding platform all mounted on one bogie. The crusher is suitable for ordinary road material, say, 2½in. or 2in. ring, and it can handle from 7 to 9 tons per hour. On the stand, too, were a 24in. Disc Crusher, with a capacity of some 15 tons per hour of ¾in. ring material for the top dressing of roads, and a 16in. by 5in. Jawbreaker Granulator, besides the firm's usual exhibits of articles of numerous kinds made of special steels.

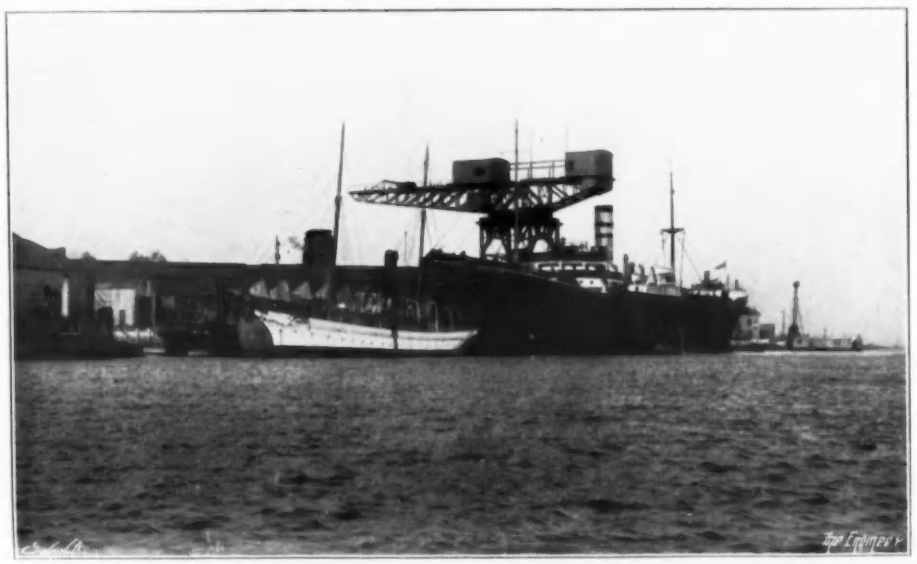
SOME OTHER EXHIBITORS.

R. A. Lister and Co., Ltd., of Dursley, Glos., showed, amongst other things, a rail truck suitable for a 24in. track and a narrow elevating platform truck with a 20in. wide platform. The Eagle Engineering Company, Ltd., of Warwick, exhibited a trailer dustless collection equipment and a two-wheel refuse trailer with patented covers. Two "Montania" locomotives, one with a Diesel engine and the other petrol-driven, were, among other things, shown by William Jones, Ltd., of 154–5, Upper Thames-street, London, E.C. 4. Rotary and fixed screens of various types were on the stand of Parker, Winder and Achurch, Ltd., of Birmingham. A prominent feature on the stand of W. and J. Glossop, Ltd., of Hipperholme, Halifax, was a steam-operated 1000-gallon automatic spraying machine for road dressing.

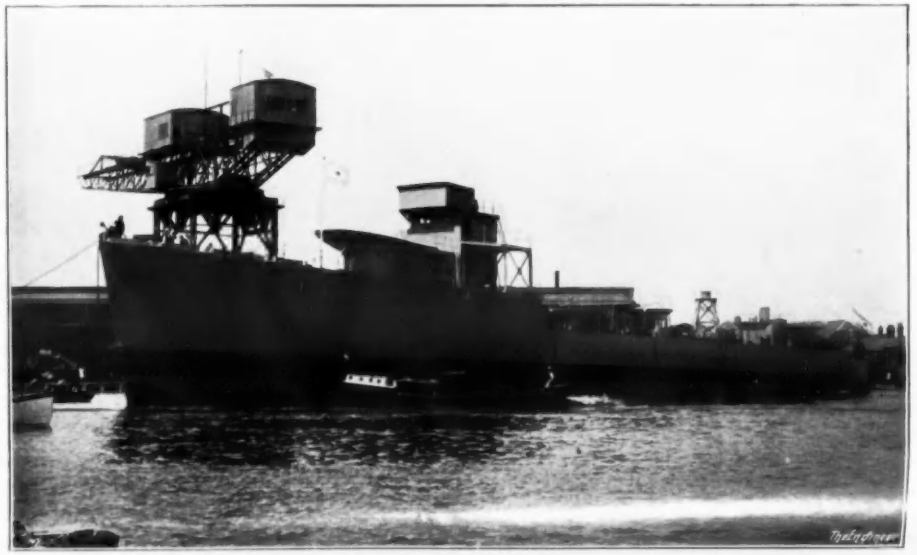
UNIV. OF ILL.

THE SHIPYARD AND ENGINE WORKS OF J. SAMUEL WHITE AND CO., LTD., COWES, I.O.W.

ENGINE WORKS AND FITTING-OUT QUAY AT WEST COWES



VESSELS AT THE FITTING-OUT QUAY

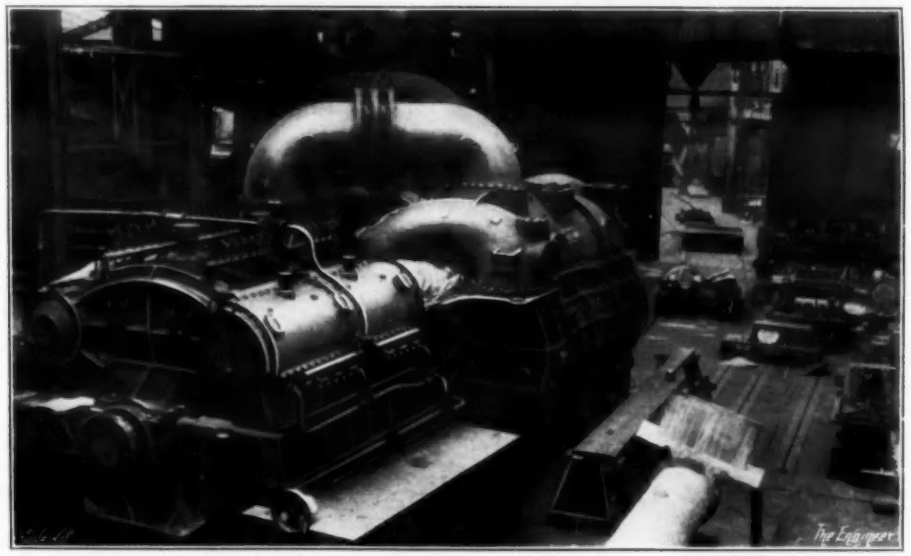


AN ARGENTINE FLOTILLA LEADER BEING FITTED OUT

VESSELS AT THE FITTING OUT QUAY

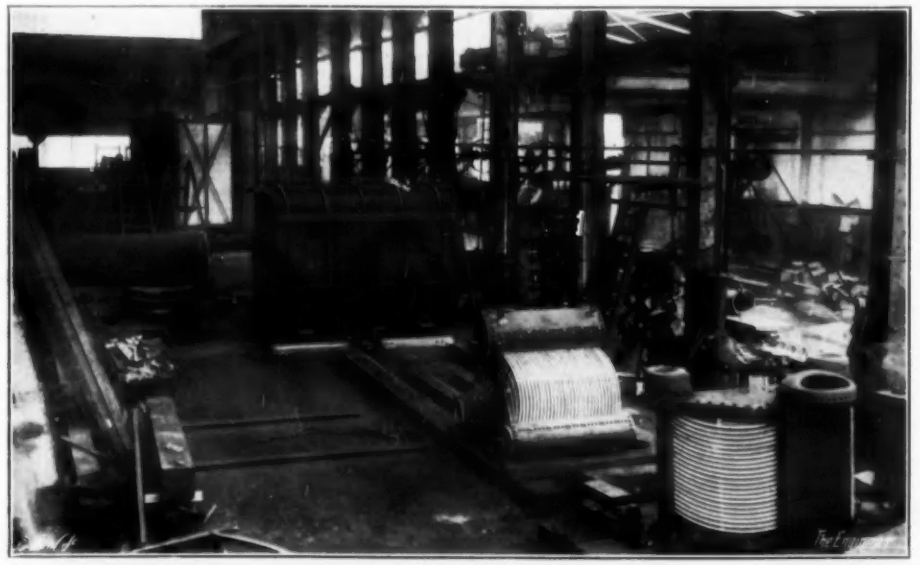
AN ARGENTINE FLOTILLA LEADER BEING FITTED OUT

VIEW IN HEAVY MACHINE SHOP



22,500 S.H.P. GEARED TURBINE ON TEST

WHITE-FORSTER BOILERS IN BOILER SHOP



ANOTHER VIEW IN THE BOILER SHOP

UNIV. OF TOM

Electricars Ltd. had sent a 2-ton low-loading refuse collection vehicle and a 1-ton commercial vehicle chassis for local delivery. Both were excellent, but neither possessed any special novelty.

Modern Concrete Development Company, Ltd., of Caxton House, Westminter, showed its concrete-mixing machine, which is fitted with a vacuum arrangement for extracting the air during mixing. The extraction of the air is claimed to add greatly to the compressive strength of the concrete, to give a much greater resistance to attrition and to render the concrete impervious to water. B. Johnson and Son, of Ilkley, were again showing examples of their handy power-operated tampers for excavation refilling, one of which we described some years ago. On the stand of Blackstone and Co., Ltd., of Stamford, Lincs., there was a 55 B.H.P. single-cylinder horizontal heavy-fuel-oil engine, shown turning round slowly, and a 3in. "Unchokeable" pump direct-coupled to a 5 B.H.P. "No Trouble" petrol engine.

As usual, Goodwin, Barsby and Co., Ltd., of Leicester, had an extensive display of stone-breaking machines, including a 30in. "Acme" granulator, a 24in. by 12in. "Good-Win" lever-type stone breaker, and 30in. by 18in. "Good-Win" crushing rolls. There were also several concrete mixers. Carbic Ltd. showed acetylene generators and a whole host of appliances for using acetylene. Cooke, Troughton and Simms, Ltd., of Broadway-court, Westminster, had a representative collection of surveyors' levels, theodolites, tacheometers, &c., as well as of surveyors' staves and drawing-office equipment.

Stothert and Pitt, Ltd., of Bath, were in their accustomed place, and had on their stand a tar-macadam plant, designed to have an output of 70 tons per 8-hour day, and several concrete mixers. All these machines have been described in our columns. Bristowes Machinery Ltd., of Angel-road, Edmonton, N., had an extensive display of machines designed for use in the making and maintenance of roadways, including an oil-fired rotary dryer, a 10-ton asphalt plant, tar and bitumen boilers and sprayers, &c. The Bromford Tube Company, Ltd., of Aston, Birmingham, exhibited examples of weldless steel tubes for numerous purposes. Fodens Ltd., of Sanbach, showed one of its standard model steam tractors. The British Steel Piling Company, Ltd., of 54a, Parliament-street, London, S.W. 1, in addition to its usual exhibit, had on view an excellent model showing the manner in which its steel piling is being used for forming the sudds for the construction of the Nag Hammadi Barrage. The Paterson Engineering Company, Ltd., of Windsor House, Kingsway, W.C. 2, showed examples of its various types of chlorinating apparatus. Two sizes of crushers and granulators and a refuse masticator were on the stand of the Patent Lightning Crusher Company, Ltd. All sorts of machines and appliances for rock boring, including its drill sharpening equipment, were shown by the Climax Rock Drill and Engineering Works, Ltd., of Carn Brea, Cornwall.

The Chaseside Engineering Company, of Enfield, again exhibited its "Hi-Lift" and "Lo-Lift" shovels. Air Pumps, Ltd., of Emerson-street, Southwark Bridge, London, S.E. 1, showed several portable air compressing plants and some smart-looking electrically-driven garage pumps. Some exceedingly business-like vehicles were to be seen on the stand of Shelvoke and Drewry, Ltd., including a 10 cubic yard capacity "Freighter Dustless Loading Refuse Collection Vehicle," and one of 7 cubic yards capacity, and a 6ft. 9in. wheel base freighter chassis fitted with hydraulic tipping gear. Plant for welding, both by acetylene and electricity, were exhibited on the stand of Allen-Liversidge, Ltd., of Victoria Station House, Westminster, S.W. 1. Models of various types of filters which it constructs were shown by Bell Brothers (Manchester, 1927), Ltd., of Denton, Manchester. F. C. Barnes, of Godalming, exhibited his tar-spraying and road-brushing machine. A tarmacadam plant was on view on the stand of Braham, Patterson and Benham, Ltd., of Limehouse, E. 14. An interesting collection of surveying and other instruments, as well as photo-copying plant and drawing-office equipment was shown by J. Halden and Co., of Manchester.

There was the customary display of fixed and flashing road beacons, &c., by the Gas Accumulator Co. (United Kingdom), Ltd., of Brentford. Several small non-chokeable pumps were exhibited by the Wallwin Company, of Warwick. Some feeding mechanisms, in which chains of various types are employed to control the flow of materials from storage hoppers, &c., were shown by Ross Patents, Ltd., of 2, Victoria-street, Westminster. A model of a Universal excavator and various types of grab, appeared on the stand of Priestman Brothers, Ltd., of Hull. Some pretty little models of stone-breakers, &c., were exhibited by Robert Broadbent and Son, Ltd., of Stalybridge. Hans Renold Ltd., of Didsbury, Manchester, had hit upon the idea of displaying the different types of chains which it makes, by having a framework carrying numerous pairs of sprockets connected by all sorts of its chains intended for a number of purposes. Several varieties of automatic gas controllers and time switches formed attractive exhibits on the stand of the Horstmann Gear Company, Ltd., of Bath.

Some efficient-looking pipe cutting machines, one of them of quite large size, and a "Driltaparatus" for drilling and tapping pipes under pressure, were shown by Weston, Shipley and Weston, Ltd., of Leicester. Electric accumulators and examples of the lock nuts made by Vislok Ltd. were exhibited by the Tungstone Accumulator Company, Ltd., of St. Bride's House, Salisbury-square, London, E.C. 4. Jigging and vibrating screens of various types were on the stand of Huntingdon, Heberlein and Co., Ltd., of 47–51, King William-street, London, E.C. 4. In addition to a tar-spraying machine and different types of grit-spreading machines, a roller divided up into a number of sections and specially intended for tarry and bituminous surfaces, was exhibited by Thomas Coleman and Sons, of Derby. Several different types of tar and bitumen-spraying machines were shown by W. Weeks and Son, Ltd., of Maidstone.

In fact, the Exhibition was fully representative of all the numerous activities connected with road construction and maintenance, and to a limited extent, with transport upon the roads when made. In other directions, too, there were some excellent exhibits. The Show was certainly a good one. It quite equalled any similar shows which had preceded it, and, in some respects, it surpassed all of them.

The Control System of the London Power Company.

FOR its effective operation the control of a system such as that of the London Power Company necessarily involves the collection of a considerable amount of data with regard to the frequent changes in climatic conditions, as the area supplied is very sensitive to the intensity of the light or the degree of visibility and the degree of temperature. As a result of a careful study of weather conditions against load demand, the control engineers have been able to collect valuable information which serves to guide them in determining what load will be required of the generating stations from day to day and from hour to hour. For each successive week a schedule is prepared disclosing an estimate of the morning and evening loads expected under normal conditions, and is sent in advance to the stations so that the necessary plant may be held in readiness.

The schedule not only provides the station engineers with a knowledge of the extent of the loads to be met, but it enables them to arrange their programme of work with regard to the undertaking of repairs and maintenance without jeopardising the positions of the stations if a greater demand should be made upon them. In order that they may be fully aware of the position of each station, early each morning the control engineers obtain from the several generating stations information as to the amount of plant available, and any mishaps affecting plant capacity are immediately communicated to the control centre and recorded. By observing the daily actual load demand at or about 8 a.m. and after studying the weather conditions by means of functional constants or by reference to specially prepared curves, the control engineer is able to estimate the morning peak load, and with this estimate before him he allocates the anticipated total loads to the various generating stations. At about the hour named each station is notified as to what proportion of the load it will be expected to meet at the morning peak; what plant it should have on the line and the amount of power to be held in reserve. The same procedure takes place at about 2 p.m. in connection with the evening peak load.

Twice daily the estimated load and the actual load obtained are recorded on a chart of sufficient size to accommodate the necessary data for one month. This chart is analysed daily and in various columns new functional constants are set down for future reference. In order that the control engineer may have in front of him a picture of the conditions at each of the stations in service, the plant in use, that available and that out of commission at each generating station is recorded daily on a card in diagrammatic form. The load demand on any section of the system is also shown in diagrammatic form, so that at times of peak load the power demand on each generating station and section of the system to which it is feeding is at once evident.

In order to ensure conditions of safety to individuals and to the system generally no switching operations are permitted without the consent of the control engineer, nor can any work be begun on any E.H.T. apparatus until he has sanctioned the issue of a "permit to work" card. Very exacting general regulations have been issued covering the operations and maintenance of E.H.T. cables, switchgear and other equipment. During periods of emergency no switches are allowed to be operated without the consent of the control engineer, and at such times only directions coming from the control centre are acted upon. Special instructions have been issued to cover conditions arising when a state of emergency exists, so that the control engineers may be confident that their instructions will receive immediate attention. Disturbances on the system are at once reported, and when the full facts have been obtained a thorough investigation is made as to the cause and what steps are necessary to prevent a recurrence. The effect of all disturbances in every section of the system is recorded on specially prepared charts, a study of which enables steps to be taken to eliminate some of the effects or to modify them.

The control of the 22,000-volt interconnected system of the London Power Company is directed from Ergon House, Horseferry-road, Westminster, where one or more control engineers are always on duty. The control room is approximately 35ft. square. It is well provided with natural light, and it occupies a position in the building that is quiet. From this room the control of the whole of the system of the company is effected, largely through the medium of a system of telephonic communication between the control centre, generating stations, switching stations, and all the principal sub-stations connected to the system. The control desk, which is approximately in the centre of the room, is divided into three sections. The centre portion is designated the control switchboard, and is flanked on each side by control desks, which are equipped with telephones by means of which any point of the system can be communicated with. At these desks the control engineers sit and control the system. Immediately in front of the control desk and some 13ft. from it is a steel structure which may also be divided into three sections—a centre panel and right and left wings. The left wing is designated the instrument panel, and is equipped with instruments for indicating the operating steam pressure of the boilers at each generating station, the total instantaneous output, the voltage and the frequency or electrical speed of the generators. This information is transmitted automatically from each generating station to the instruments on this panel in the control room by means of pilot wires laid between the generating stations and Ergon House, so that the indications of the master instruments in the generating stations are faithfully reproduced on the instruments in the control room. At the top of the left-hand wing or instrument panel there is a voltmeter which indicates the pressure of the interconnected system, whilst by means of a multi-way switch the voltage at any one of the generating stations can be indicated on this instrument. At the bottom of the left-hand wing is the frequency or electrical speed indicator of the system.

The central panel is designated the system diagram panel, for upon this panel the whole system is depicted diagrammatically. All feeders and interconnecting cables between generating stations, switching stations and distributing stations are depicted by monel metal strips, and on account of its untarnishable qualities, this metal is also used for the plinth, beadings, and scrolls. To this diagram the control engineers are constantly referring, as it indicates to them the manner in which the system is electrically coupled and the "in" and "out" position of every switch on the system.

The switches at every generating station, switching station, and distributing station are represented on the diagram by small glazed holes, called "light windows," and by means of a special system of lighting a green light or a red light appears in the window, according to whether the switch at that particular point is closed or open. The absence of a light in a window is an indication that the particular switch is out of commission, and that it is isolated. The illumination of the "light windows," representing switches on the system, is controlled from the centre portion of the control desk, called the control switchboard, by means of miniature switches operated by the control engineers. By means of the telephone the control engineer communicates with a responsible person at the point at which he requires an alteration to the switching conditions to be made, and on the completion of the operation, by means of the miniature switches on the control switchboard, he repeats the operation he directed to be carried out, thus reproducing on the "mimic" diagram the altered condition of the switching at the point in question. The operation described is called "dressing the board." Every light window representing a switch on the mimic diagram has a corresponding miniature switch on the control switch board, and each switch has a coloured handle conforming to a colour scheme which has been introduced in order to facilitate the dressing of the "mimic" system diagram, so that in effect the control switchboard is a check upon the "mimic" system diagram.

At the bottom and left-hand corner of the control or system diagram panel there is a "plant panel," upon which there is a "light window" for every boiler and generator installed at each of the generating stations. The illumination of these light windows is also controlled by the control engineers, and is based on information obtained from time to time from the various generating stations. The control engineers are thus enabled at any time to observe at a glance the boilers steaming, the boilers in reserve, those out of commission, the generators on the line, those in reserve, and those out of commission. Every boiler and generator is numbered and has its own light window. A red light in the window indicates that a boiler is steaming or that a generator is on the line, whilst a green light indicates that a boiler or generator is held in reserve. The absence of a light indicates that the plant is out of commission.

Immediately above the central panel there is a kilowatt indicator, which gives the total instantaneous load on the whole of the 50-cycle system of the company, the instrument indicating the summated readings of the individual station output instruments. In the centre of the lower panel below the system diagram there is a cyclometer which indicates the total output capacity of the generators connected to the system, so that by deducting from the reading of this instrument the reading of the kilowatt indicator the amount of reserve output is immediately obtained.

At present the right-hand wing is unequipped, but it is held in reserve for the accommodation of any instruments which may be necessary for indicating the load and other electrical connections at the several points of connection between the Power Company's system and the grid or other lines of the Central Electricity Board. On the right-hand wall of the control room there is a case containing a swinging pendulum, constituting the device for maintaining standard frequency over the whole system. The lowest dial has a special pendulum clock, and indicates Greenwich mean time, and is designated the master clock, whilst the centre dial has a clock driven by a small synchronous motor connected to the interconnected system of the Power Company. The top dial is combined with the lowest and centre dials, and consequently it indicates the deviation between electrical time and Greenwich mean time, or, in other words, it provides an indication of the amount by which the summated frequency of the electrical system is gaining or losing in comparison with standard time. Practically similar instruments are installed in the generating stations, and so far as Greenwich mean time is concerned, they are controlled by the master clock in the control room at Ergon House. Thus any departure from standard frequency or the electrical speed of the system is at once seen and corrected. Electrical time or frequency of the system is shown on the top dial by the movement of a red hand, whilst Greenwich time is shown on the same dial by the movement of a black hand, so that if the frequency of the system is greater than it should be, the red hand will be

in advance of the black hand, and conversely if the speed of the system is less than it should be, the red hand will be moving behind the black hand.

The equipment of the control room has been specially designed to meet the requirements of the Power Company, and it embodies many special features, but time must elapse before the room can be furnished in a manner consistent with all the details of operation with which it will have to deal as the system develops. In designing the present equipment attention has been paid to the desirability of maintaining personal contact between the control engineers and the *personnel* of the various power-houses, switching stations and sub-stations, and for this reason the employment of automatic indications has been reduced to a reasonable minimum consistent with the foregoing requirements and the avoidance of the use of complicated transmitting and recording instruments.

South African Engineering Notes.

Railway Earnings.

THE earnings of the South African Railways continue to increase as compared with the corresponding period in last year. For the week ended September 28th the amount was £525,568, compared with £515,992 for the corresponding week of last year. The total from April 1st to September 28th was £13,088,375, compared with £12,756,729 for the corresponding period of last year.

More Rolling Stock Needed.

The South African Railways are to spend another £75,000 shortly in increasing the rolling stock for the coal traffic. Tenders have recently been invited for the supply of 150 50-ton steel bogie wagons, which are needed for dealing with the coal traffic at the peak period. Another interesting item is the contemplated expenditure in the provision of another twin-screw grab dredger for service at Union ports.

New Gold Extraction Process.

From reports furnished to the Davidson Process Development Syndicate, it would appear that a Mr. Davidson, Johannesburg, has invented a simple, inexpensive, and effective process of extracting gold from refractory ores. Mr. W. F. H. Dudgeon, the consulting engineer to the syndicate, has reported that he has satisfied himself that the process is a simple and unexpensive one to run, and for refractory ores, such as the Black Reef, it fulfils Mr. Davidson's claims of extracting all the free gold and platinoid by amalgamation only. So far, however, no details of the process have been made public.

Coke Production.

Consequent on a preliminary investigation into the coking possibilities of the coal of the Witbank district of the Transvaal, an experimental washing and coking plant has been erected by the Transvaal Coal Owners' Association. This plant is situated on the property of the South African Coal Estates, and it is stated that it will not be long before those collieries which prove able to produce satisfactory coke will be in a position to make an offer to the iron and steel industry for its requirements. Further investigation has also been made into the question of oil extraction from coal, and samples have been sent overseas to interested and influential concerns working in this direction in Germany and Britain. The reports so far received have been promising, and there will be a great future for the coal industry should one of these concerns interest itself in any of the South African coal propositions for that purpose. The Government is already taking an active interest in the matter, and the chances of South Africa being able to produce oil in the near future on a commercial scale are regarded as hopeful.

Oil from Coal.

It may here be explained that a scheme for the low-temperature distillation of coal, which is reported to be of great promise, has been worked out by Mr. Tom R. Sharkey, of Durban, and a pilot plant on a full working scale is to be erected by Oil Retorting Industries, Ltd., probably at Colenso, in conjunction with the E.S. Commission's power station. If this plant fulfils expectations, there is reason to expect that the Commission will itself develop the process on a big scale at Colenso, to deal with the coal supplies from that and the Congella stations. The coarser part of the low-temperature coke would be screened out, and used on the chain grate stokers at Colenso, while the fine material would be railed to Congella. It is claimed that the latter coke would be more readily pulverised than duff and would have practically the same heat value, pound for pound, as the original coal.

Remodelling the N.C.C.R. Line.

Between Worcester and Riversdale, in the Cape Province, 154 miles of railway have been relaid in the last year or so, 100 miles with new rails and the remainder with rails taken up from the Cape Western system. This work has cost over £500,000, and an additional £500,000 will be required to complete the relaying scheme through to Mossel Bay. Since the section of line between Worcester and Mossel Bay was taken over from the New Cape Central Railway in 1925 efforts have been made to bring it up to the standard of other important lines of the South African Railways. In addition to relaying the section with heavier rails, which is more than 80 per cent. complete, and the strengthening and replacement of bridges, which is well in hand, various improvements to stations, station yards and sidings have been carried out. During October some new engines, capable of hauling 350 tons, were introduced on this line, and the journey between Cape Town and Mossel Bay is to be accelerated. In eight months' time much of the goods traffic between Cape Town and Port Elizabeth, now consigned *vid* De Aar, will be diverted along this line. Excellent developments have attended the introduction of the road motor service between Ashton, Montagu, Dams River and Buffeljogt. These alterations and improved methods have resulted in the traffic over this section being increased by approximately 60 per cent.

An Accurate Cold Heading Machine.

THE cold heading machine which we illustrate by the general view in Fig. 1 below, has recently been brought out by Mr. Edward White, of Windsor Works, Redditch, for the purpose of making such objects as rivets, screw blanks, and so forth, with an exceptional degree of accuracy. It will, in fact, work to the nearest 0·002in. This result is attained by the provision of fine adjustments in many parts of the machine, such as the wire feed, the wire stop, the

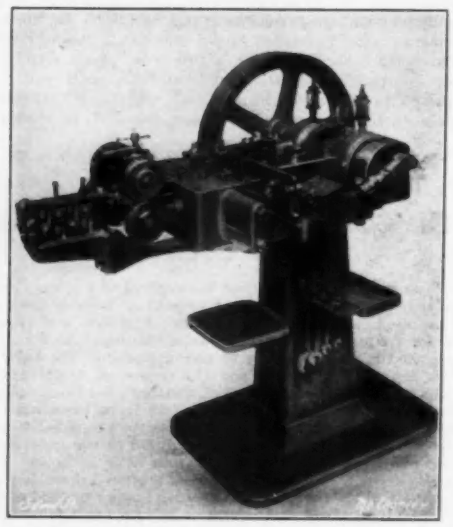


FIG. 1—COLD HEADING MACHINE

transfer slide travel, the transfer grip, the punch—both horizontally and vertically—the knocker out, and the cut-off and transfer slide cam. We illustrate several of these adjustments in the half-tone engravings and drawings.

For high-class work, such as this machine is intended to perform, it is necessary to use a solid die, as an opening die must leave a mark or ridge round the head. As a consequence, the operations of cutting-off the wire from the stock and heading it up are performed in two separate dies, and the wire has to be transferred from one die to the other.

Although this transfer mechanism is perhaps one of the

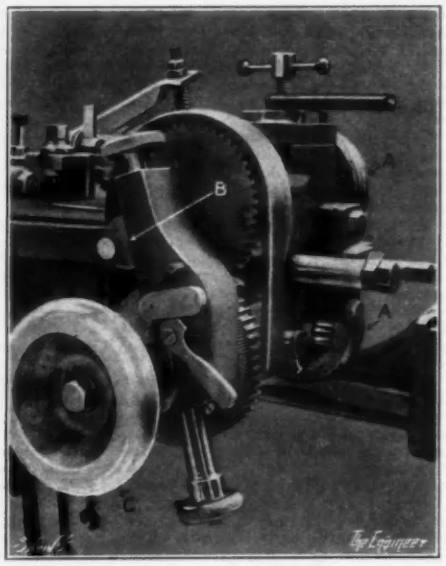


FIG. 2—FEED ADJUSTMENT

most interesting parts of the machine, it may be as well to start first with the feed mechanism.

The wire from which the pieces are made is drawn from a swift through a roll straightener by a pair of grooved rolls A, one above the other, plainly shown in the background of Fig. 2. These rolls are given an intermittent partial revolution to feed the wire forward, and the extent of their angular movement naturally decides the amount of wire fed. This movement is provided by an excentric on the countershaft and the excentric rod shown on the right of Fig. 3, which operates a pawl and ratchet wheel on one of the feed roll shafts. In view of the fact that it is probable that the length of feed must be adjusted to a higher degree of accuracy than is attainable with one ratchet wheel, the angular movement of the pawl-carrying arm is made adjustable regardless of the throw of the excentric. This adjustment is effected by means of the sliding block shown in Fig. 2 at B and in Fig. 3, to which the excentric rod is attached, so that the effective leverage of the pawl arm may be varied and the oscillation of the feed rolls adjusted within very fine limits. It will be noticed that a hand wheel C is provided for feeding up the wire quickly when starting work. As a final precaution against inexact length of the wire feed, there is a dead stop against which the stock is pushed.

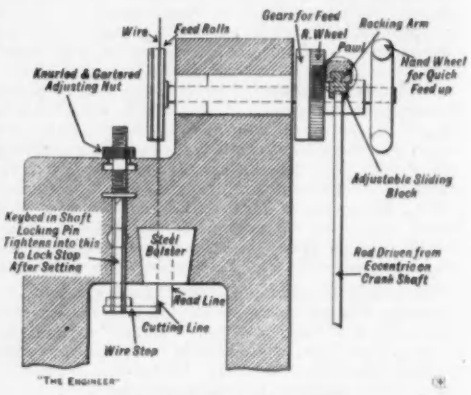


FIG. 3—FEED MECHANISM

This stop—see Fig. 3—has a micrometer adjustment, and if an excess of wire is fed forward slipping takes place in the feed rolls. Fig. 3 also shows the relative positions of the cutting off and the heading dies, and the substantial nature of the framing of the machine.

The length of wire for each piece is cut off by a simple

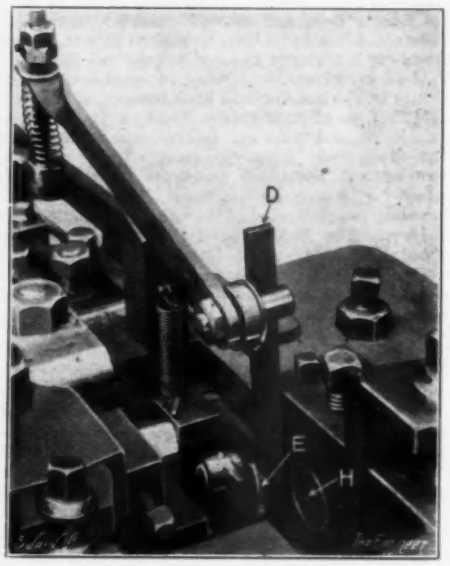


FIG. 4—CUT-OFF TRANSFER MECHANISM

shearing action against the mouth of the die. This mechanism is illustrated by Fig. 4, and the knife itself is most plainly shown in the sketch, Fig. 5. It will be seen that a semi-circular notch is made in the cutting edge of the knife E, which is utilised to hold the cut-off piece of

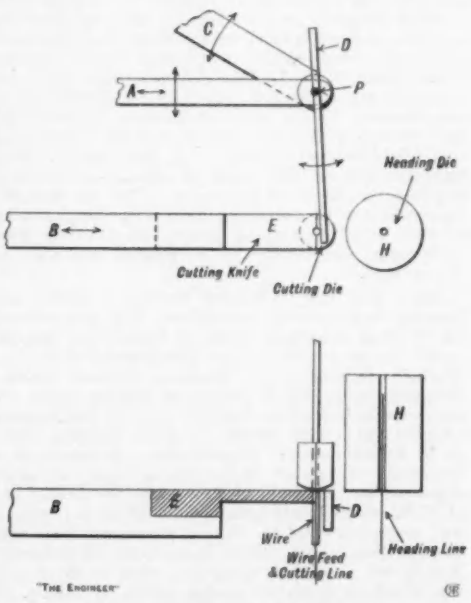


FIG. 5—CUTTING-OFF MECHANISM

wire, while it is being transferred to the heading die H. It is, of course, necessary to hold the piece in this notch during its transference, and this is effected by the finger D. This finger is mounted on the end of a lever C, which is pivoted at P on the lever A. This system of levers is con-

nected with the ram B of the cutting knife, and is operated by a double path cam. The movements of the levers are indicated by arrows. Thus A can move vertically and horizontally, while C and D oscillate together. The result is that D can move in any direction in one plane.

In action the wire is fed forward against the stop—not shown in Fig. 5, but visible in Fig. 4—the knife advances, cuts off the piece and presses it against the finger D. The whole motion—A, B, C, D, E—then moves across to the centre line of the heading die H. The heading punch—see Fig. 6—then comes up and starts to push the piece into the heading die. Immediately afterwards the whole transfer mechanism recedes, the finger D passing over the top of the wire ready to receive a fresh piece of wire. The heading die continues its stroke, and forms the head to make the finished piece. The lifting of the finger D over the top of the wire is effected during this part of the stroke by a taper on the die punch.

As the main slide and punch—S, Fig. 6—return, the finished piece is ejected from the die by a knocker-out pin,

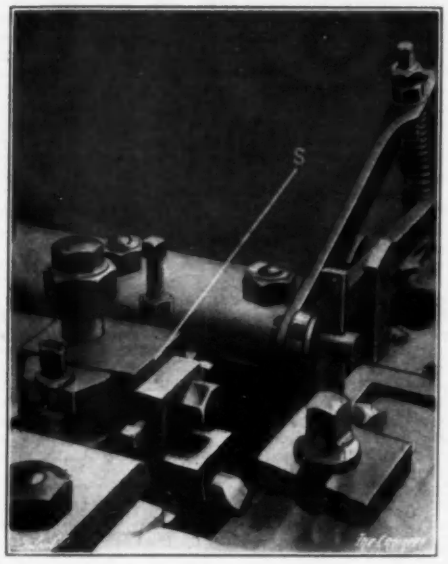


FIG. 6—HEADING PUNCH

which works backwards and forwards in the back of the die, and is actuated by the slide itself. The various mechanisms are so interconnected that it is practically impossible to jam the machine, but an added precaution is provided in the form of a spring catch in the drive of the cut-off cam, which gives, should any undue pressure occur on the transfer finger or cut-off knife.

The moving parts of the machine run on bronze slides of large area, arranged on the outside of the machine, so that they are readily accessible, and can be properly adjusted. As a consequence, the machine runs very smoothly and without whip. The normal running speed is 180 strokes per minute, but it can be safely run up to 260 strokes per minute. The machine is made in six sizes, for wire from 0·032in. up to 0·19in. and for blanks up to 4½in. long.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

No Change.

THE situation in the iron and steel and heavy engineering industries in the Midlands and Staffordshire is much as it was last week. A decline in new business from now until the end of the year is to be expected. On 'Change in Birmingham to-day—Thursday—there was a good attendance, but buying was dull. No new features developed, and nothing was added to the trade momentum.

Finished Iron.

Finished iron of Staffordshire manufacture for engineering purposes is being bought regularly and mills are in a reasonably strong position. Marked bars are maintained at £12 10s. per ton. Makers of Crown quality bars are making very little progress in their efforts to stabilise prices at £10 7s. 6d. Though this price is occasionally paid, selling values vary between £10 and £10 7s. 6d. Common bars for the nut and bolt and fencing industries are quoted £9 to £9 5s., but the tonnage sold is relatively small. Continental bars, whether in steel or No. 3 iron, can be had at £6 7s. 6d. delivered in the district. Most of the available business goes abroad. There is no change in the position in the iron strip department. Business is good, prices are firm, and makers are well supplied with orders.

Steel.

Local steel works have booked a few orders this week, and there are more in prospect. There are, too, more inquiries for heavy steel from constructional engineers, as a little more business is being done in that branch. Steel works are not so well employed as they were in the early autumn, but there is still a fair amount of employment on shipbuilding material. Strip and sheet mills, which supply the special requirements of the motor car industry, are steadily employed again after the intermission of demand between the selling seasons. The Steel Association maintains the price of joists and sections at £8 2s. 6d. with ship, bridge and tank plates at £8 17s. 6d. In semi-finished steel business is slow, and continental competition is blamed for the dullness of the market. English and Welsh firms quote £6 5s. for billets and £6 2s. 6d. for sheet bars. The continental position has been gradually weakening. On 'Change in Birmingham this week 2in. billets could be bought at £5 10s., perhaps less, delivered buyer's works. There is no material change in the prices of other imported steel, but the disparity between home and foreign values is sufficient to divert orders abroad. The steel scrap market is weak. Merchants contend that the slowing down at the steel works has reduced the demand for delivery of heavy steel scrap, and where purchases have to be made prices are cut.

Pig Iron.

Foundry pig iron is being consumed in good quantities, and furnaces in Northamptonshire and Derbyshire have no difficulty in disposing of their output. Some merchants still complain that it is difficult to get prompt delivery, especially from some of the Derbyshire furnaces. The Association prices are firm at £3 15s. for Northamptonshire, £3 19s. 6d. for North Staffordshire, and £3 18s. 6d. for Derbyshire, all No. 3 foundry quality delivered within the specified zones. Forge iron is 4s. less in each case, and demand is rather poor, as users are holding out in the hope of concessions. In the present fuel position, however, there is little hope of cheaper pig iron. The coke ovens have as much as they can do to cope with the demand from the furnaces and maintain prices on a high level. The Central Pig Iron Producers' Association last week held its ordinary monthly meeting. Representatives of the merchants attended to discuss terms which have rankled since the establishment of the control. It was afterwards stated that nothing decisive had been done. The meeting was not concerned with the question of basis prices, inasmuch as they have been fixed till the end of January, and the further outlook is full of uncertainties.

Galvanised Sheets.

Galvanised sheets show no improvement on the situation of the last few weeks. Competition in the contracted market has brought prices even lower. Supplies of 24-gauge corrugated were freely offered on 'Change in Birmingham this week at £12 12s. 6d. Some buyers said they were able to get supplies at £12 10s. The continued recession of galvanised sheets is attributed in part to the effect of cheap spelter, which induces the bigger firms to lower their prices for the finished article in the hope of stimulating demand. At present, however, the absorptive capacity of the overseas markets shows little sign of recovery. Indian business is disappointing and the South American market, which looked more promising a short time ago, is not coming up to expectations. Demand from the home country is meagre. Mills are now very short of orders.

Future of Mechanical Engineering.

Sir Charles Grant Robertson, Principal of Birmingham University, at the annual dinner of the Midland Branch of the Institution of Mechanical Engineers in Birmingham on November 28th, gave it as his opinion that there was a better future for mechanical engineering, in the true sense of the term, than even for its sister branch—promising as that was—electrical engineering. He admitted that was not the general view. Mechanical engineering was pure science in relation to different forms of human activity, and unless it worked and stood by the principles of pure science it would go back. There would be a considerable advance in the next ten years, he believed, and the changes in the mechanism of modern society were going to be more closely related to the functions of mechanical engineering than of electrical engineering. Were he asked to select two professions which had the greatest future before them, he would say biology and mechanical engineering.

Electricity Extension at Coventry.

The Coventry Corporation Electricity Committee recommends the installation of an additional 25,000 kW turbo-alternator, with buildings, switchgear, &c., at the Longford generating station, at an estimated cost of £162,000. The City Council is recommended to seek approval to a loan for that amount and for one for £4018 for mains extensions and other works. It is pointed out by the electrical engineer that the present earning plant capacity at the Longford station is 39,750 kW, and that the anticipated maximum load this winter will exceed 38,000 kW. The extension of plant is necessary in order to meet the estimated load for 1930–31.

Birmingham and the Metal Trades.

The annual dinner of the Co-ordinating Committee representing the Staffordshire Iron and Steel Institute, the Birmingham Metallurgical Society, and the local section of the Institute of Metals, took place in Birmingham on November 30th. Mr. P. Jump presided, and among those present were the Lord Mayor—Alderman Lancaster—Dr. Walter Rosenhain—President of the Institute of Metals and director of the Metallurgical Department, N.P.L.—and Mr. Walter Barrow—President of the Birmingham Chamber of Commerce. Mr. Walter Barrow, in proposing the toast of the Societies, emphaised the relation of the progress of the metal industries to the prosperity of Birmingham. The city, he said, was absolutely dependent upon the prosperity of the metal trades. In the course of his speech he dealt with the enormous changes which had taken place in the industries, and mentioned that in the past the Black Country used to produce iron and steel from raw materials raised in the district, but that, to-day, things had so changed that even coal was imported from other districts to the Black Country. Dr. Rosenhain said that the co-ordination of a number of societies for the purpose of maintaining a unified programme was an experiment which had not been tried except in Birmingham, but it was an experiment which was proving so successful that he would not be surprised if it were attempted elsewhere.

Orders for Railway Wagons.

The Central Argentine Railway has placed with Midland firms orders for 2400 freight traffic vehicles. The Metropolitan-Cammell Carriage, Wagon and Finance Company, Ltd., is to supply 2060 all-steel 20-ton goods wagons, and the Birmingham Railway Carriage and Wagon Company, Ltd., 351 all-steel vans.

Warwickshire Miners' Wages.

Wages of miners engaged in the Warwickshire coalfield will, during December, be the same as during October and November. They will be based on the 45 per cent. basis.

Unemployment.

The latest returns of unemployment for the Midlands show an increase of 2499, the total having risen from 152,613 to 155,112. Increases occurred at Birmingham, Bilston, Cradley Heath, Derby, Leamington and Warwick, Oldbury, Peterborough, Redditch, Stoke-on-Trent, Walsall, Wednesbury, West Bromwich, and Worcester, and decreases at Coventry, Dudley, Leicester, Northampton, Nottingham, Smethwick, Stourbridge and Brierley Hill, Tipton and Wolverhampton. Birmingham's workless now number 24,001.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Rationalisation Scheme Withdrawn.

A RATHER interesting development in respect of the proposed scheme of rationalisation put forward recently by Mr. M. C. Harman, the chairman of John Hetherington and Sons, Ltd., textile machinists, Manchester, has occurred this week. At the beginning of October Mr. Harman circularised direct the shareholders of a number of Lancashire firms engaged in the manufacture of textile machinery and outlined a plan for the rationalisation of the industry, which entailed the formation of a new concern to be known as the Textile Machinery Union, Ltd. The proposal was not sympathetically received by the boards of directors of the majority, at all events, of the companies concerned, and judging from the general expressions of opinion at the time there appeared to be little likelihood of its adoption. One useful effect which the publication of the scheme has apparently had, however, has been to focus the attention of directors of textile machinery companies upon the question of rationalisation, and Mr. Harman explains this week that it is in consequence of a recent conference which was attended by representatives of a number of Lancashire companies, and in accordance with a promise he made to shareholders at the time they were approached by him, that within a specified period he would declare the plan to be either operative or non-operative, that he now declares it to be non-operative. At the conference referred to the question of closer working between the various concerns was discussed, and Mr. Harman's expressed view is that the discussion "should be given every opportunity of bearing fruit."

After Eighty Years' Service.

The London, Midland and Scottish Railway Company proposes to rebuild one of four railway bridges, erected originally in 1845, in Irwell-street, Salford, and the City Engineer of Salford has been instructed by the Improvements Committee to confer on the matter with the railway company and with the Ministry of Transport. As it now is, the bridge is supported at each end by iron columns, and in view of modern traffic conditions, the Improvements Committee considers it desirable that the new structure should be of such a type as to do away with the necessity for obstructions of this kind.

£150,000 for Electricity Distribution.

Manchester Corporation Electricity Committee is seeking the authority of the City Council to borrow the sum of £100,000 for feeder mains and £50,000 for distributing stations, and in putting forward the proposal the Committee expresses the belief that the expenditure will result in profitable new business. A change in the method of calculating the basis of the "all-in" tariff for current for domestic consumption is proposed by Mr. H. C. Lamb, the manager of the electricity department. Instead of the existing practice of basing the charge on 20 per cent. of pre-war rateable values, he recommends a change to one-sixth of present rateable values. Under the North-West England and North Wales electricity scheme, the Chamber Hall station of the Bury Corporation has been scheduled as a selected station to be operated under the direction of the Central Electricity Board. It is expected that this control will come into operation about 1931.

More Roads and Bridges.

Of a total estimated cost of £2,800,000, thirty-five road and twenty bridge schemes have been submitted to the Ministry of Transport as unemployment relief measures by Liverpool Corporation. In addition, rather more than £500,000 is involved in eight road and bridge schemes which have been submitted to the Ministry separately. Application to the Ministry of Health for permission to borrow £152,000 for the purpose of carrying out a sewerage scheme is being made by Southport Corporation.

Crewe Works Christmas Stop.

The Crewe locomotive works of the London, Midland and Scottish Railway Company, which resumed full-time working last week-end after a long spell on

short-time, are to be closed down for the whole of Christmas week.

Non-ferrous Metals.

Those people who were hoping that the advances in copper and tin recorded in this column a week ago were but the precursors of a series of upward movements will have had their hopes rudely shattered by events on the non-ferrous metals market since then. Following upon the rise in copper, there has been serious reaction in standard brands of the metal, varying up to the time of writing from about £3 to £4 a ton, according to position, though refined descriptions have held firm. The demand from consumers has been rather quiet, and even speculative interests are inclined to exercise caution. To a large extent, the advance in the tin section a week ago was due to a change in market sentiment based upon hopes of developments in respect of curtailed output. These, however, have not matured, and the effect of the disappointment, coupled with market expectations of a further rise in the visible supplies of the metal, have served to wipe out the whole of the gain of the two previous weeks, the loss on balance being in the neighbourhood of £11 a ton. Supplies of spelter have been more than sufficient to meet the demand, and values have declined to the extent of about 5s., a similar loss being recorded in the case of lead.

Iron and Steel.

Although certain of the leading makers of foundry iron report being fairly well sold over the first quarter, there is nothing resembling general forward buying going on at the moment, and little change in the position is expected before the turn of the year. Meanwhile, values are quite steady all round, and no appreciable reduction in the volume of deliveries has been experienced. For delivery in the Manchester area, Staffordshire and Derbyshire No. 3 iron is quoted at 77s. per ton, with Scottish at 93s. and West Coast brands of hematite iron at about 90s. The bar iron section is extremely dull, though prices keep up at £10 15s. for Lancashire Crown quality bars and £9 15s. for No. 2 material. A seasonal slackening of activity and the fact that constructional engineers in the district have several important contracts held up for various reasons, have resulted in a restriction of the demand for steel from this direction, and a poor call for general plates is reported also. For some time locomotive boiler plates on this market have been a relatively bright feature, but here, too, inquiry has been less active than of late. Bright drawn bars are in fair demand still, but there is relatively little movement in the case of small re-rolled bars. Under the circumstances, rollers are not too cheerful just now. Prices, however, are firm in all sections at recent rates. Continental steel materials are easy and buying interest continues very slow.

BARROW-IN-FURNESS.

Hematite.

The general trend of business remains about the same, and makers are well situated as regards orders for some time to come. There is little iron available on the market, most of it being bought well forward, and some producers are booked up for the next three or four months. The home trade continues to be steady, and there are no signs of a break at present. Continental trade continues to be moderate, being mostly confined to special qualities of stated analysis. As regards American business, there will be further shipments, mostly of special qualities. These shipments include iron from various smelters in the district. Iron ore remains about the same, with a fair business outside the district. Foreign ore is in steady demand. The steel trade continues to be rather thin, and none of the works holds many contracts for railway material.

Shipbuilding.

Vickers-Armstrongs, Ld., have received an order for a fast passenger vessel for Duff and Co., of Glasgow. The tonnage of this vessel is not known at present, but the ship will be on the small side. The three Chilian submarines left Barrow on Saturday morning, and are reported to have arrived at Portsmouth safely. There are rumours of further contracts for Vickers-Armstrong, but it is too early to say anything definite about them at the moment.

SHEFFIELD.

(From our own Correspondent.)

Quiet Spell Continues.

As regards a large section of the steel industry, including that which deals with general lines of material, Sheffield is just now experiencing a period of quiet which is very disappointing, in view of the fact that this is a time of year when business usually shows an improving tendency. There has been a decline in the booking of work since the middle of October, and it has occasioned a reduction of activity at many works. The total turnover in steel material at present is probably less than that of a year ago, and there is no sign of early improvement. The weakest departments are those which produce open-hearth steel. The demand for basic, after being strong for a considerable time, has now fallen off, while the trade in acid steel has not been good at any part of the year. In Lincolnshire, however, where the basic steel trade is largely carried on, there is no diminution of activity. The steel works there are working full time, and output has been increasing for some time. In Sheffield, although there are many orders and inquiries about, they are mostly for small quantities, and makers are unable to see more than a week or two ahead with anything like certainty. A shrinkage of business is reported by the rolling mills and forges which work for hire, and they are mostly on short time.

Railway Work.

The requirements of the railway companies, both home and overseas, are gradually showing an expansion, but the departments producing axles, tires, and springs are not fully employed. The aggregate volume of work coming forward lately has been much below the pre-war standard, and owing to quicker methods of production, especially as regards tires, orders are now executed much more quickly than formerly. In the building of wagons for private owners work is on a very meagre scale. While the surplus rolling stock in the country is being gradually worked off, it is still of considerable proportions. During the week, however, some excellent orders have been placed by the Central Argentine Railway, of which the lion's share has come to the Metropolitan-Cammell Carriage, Wagon, and Finance Company, an amalgamation of Sheffield firms, which has works at Leeds and Nottingham as well as at Birmingham.

Hollow-forged Drums.

One of the busiest departments on the heavy manufacturing side is that of hollow-forged drums. John Brown and Co., Ltd., one of the firms which are specially equipped for this trade, has just secured an order for eight large hollow-forged steel drums for the super-power station at Puerto Nueva of the Compania Italo-Argentina de Electricidad, of Buenos Aires.

Lighter Steel Branches.

The lighter branches of the steel trade which produce material that is chiefly designed to meet special requirements are still busy. The manufacturers of electrical machinery and apparatus are taking large quantities of Sheffield material—indeed, their demands are said to be larger than at any previous time. There is an excellent demand for magnet steels for both home and overseas use. Expansion continues in the employment of stainless, non-corrodible, and heat-resisting steels. To the automobile industry stampings and special steels are supplied in large quantities. On this side there is an improved demand in respect of commercial vehicles and omnibuses, but the requirements for touring cars show some decline. The city supplies enormous quantities of springs to the motor trade, but in that branch it has to compete with makers in Leeds and the Midlands. Another very active branch is that of cold wrought steel. There is a large demand for strip of both large and small dimensions, new uses for which are being constantly developed.

Other Departments.

Makers of crucible steel and special tool steels are doing fairly well in the home market. A reduction of 2d. per lb. in the price of tungsten, which was made last week, will be of service to the makers of high-speed steel, but the cost of this valuable ingredient is still about twice what it was in January last. Supplies of tungsten ore are still scarce, and dear. The high prices so far have not affected the big users of tungsten much, as many of them were well bought forward at the previous low rates. Most of the contracts have now expired, however. The trade in best wires is well maintained. A good deal of wire rope is being sent abroad, but the home demand is only on a moderate scale. There is much activity in the production of heavy cast iron and composite pipes at the Derbyshire foundries, a considerable share of the work being on overseas account. Not much engineering work is on hand, except in the heating department. The call for iron and steel works machinery is very limited. The demand for agricultural steels is below the average. The light castings foundries are poorly employed, and bar iron is another weak department.

Cutlery and Plate.

There is at the moment exceptional activity in the cutlery trade, though this is not due to an expansion in the general demand, but to special causes. The principal reason for it is the placing of huge orders for articles to be sold at bazaars or distributed for advertising purposes. The pen and pocket knife department in particular is very busy on such orders. Many of the largest contracts have been placed by cigarette firms, which are giving away enormous quantities of penknives, as well as table cutlery and plated ware. The small makers are booking a large share of this special trade, but at the same time the large firms have received substantial orders for pocket cutlery of good quality from business houses of many kinds. The ordinary trade in cutlery has quietened down since the completion of the orders for the Christmas demand. There is, however, a large output of stainless table knives, scissors, and safety razor blades. Messrs. Ward and Sons, of Wardonia Works, are busy on an order for a million blades for a large concern in South Africa, one of the biggest orders ever placed in Sheffield, which follows closely upon one for half a million blades for Canada.

Steel Golf Clubs.

Sheffield stands to benefit by the decision of the golf authorities to make the use of steel golf shafts legal. There are several firms in the city which make stainless steel golf shafts, and it is anticipated that the demand will now be greatly increased.

Hull Developments.

Progress is to be reported in connection with two of the great schemes that have been before the city of Hull for some time. One is for the abolition of the level crossings and their replacement by high-level railways. Sir Henry Maybury and Mr. F. Palmer, the experts appointed by the Corporation to advise on the matter, have now presented their report, which has been adopted by the Level Crossings Committee. The total estimated cost is £1,122,249. The experts have reduced the original estimate by £7943 by avoiding the diversion of gas and water mains. The scheme will provide work for 1000 men for five years. The other great scheme is that for tunnelling or bridging the Humber, in connection with which Sir Douglas Fox and Partners were recently appointed as expert advisers. In order to enable them to make their report, their engineers have now taken borings in the Humber at four points between the St. Andrew's Dock at the west end of the city and the village of Paul, 4 miles east of Hull. The bed of the Humber is chiefly chalk, and is stated to be suitable for either a tunnel or the foundations of a bridge. The Humber Conservancy Board has expressed its grave apprehension of the possibility of the construction of a bridge over the Humber. In reply to a request by Sir Douglas Fox, the Board has refused to express opinions on any special features which a bridge would require. It is not satisfied that a bridge could be planned to carry heavy rail and road traffic that would not interfere with river navigation.

NORTH OF ENGLAND.

(From our own Correspondent.)

Decline in Iron and Steel Exports.

WHILE fairly large outputs are still being maintained in the iron and steel industry in the North of England, and orders are held by manufacturers which assure active conditions well into next year, it is somewhat discouraging to find a decrease in the exports from the River Tees during November. Various causes, such as the operations of the Continental Steel Cartel, high prices, and the financial stringency at home and abroad, are undoubtedly having a restrictive influence on new business in iron and steel, and there is a feeling in some quarters that a steady decline in the activity of the industry is developing. The contraction in the Tees exports for November is not very marked, because there were old contracts to complete, but new business is much more difficult to arrange, and the decline in the shipments is likely to be progressive. It is significant that three blast-furnaces were stopped in the Cleveland district during the past month. In each case the stoppage was due to mechanical troubles, but if the output had been needed there are plenty of idle furnaces which could have been put into commission, and the inference is that the reduced output is adequate for present industrial requirements. The total exports of iron and steel from the Tees in November reached 81,801 tons, which represented a fall of 15,063 tons as compared with the October figures. There was a decline of 2294 tons in the pig iron shipments to Scotland, and of 2745 tons in the exports abroad. The shipment of 60,283 tons of manufactured iron and steel compares with 71,153 tons in October, and is chiefly due to reduced exports to Australia and South Africa.

Cleveland Iron Trade.

The closing month of the year finds buyers disinclined to enter into further heavy commitments, but the general position of the industry remains fairly satisfactory at the moment, though the outlook is not so encouraging. Foreign iron is now going into Scotland—usually a good customer of Cleveland—in large quantities, and on the other hand the price of Cleveland iron is too high to command favour in foreign markets. Still, the whole of the output is going into immediate consumption, and the moderate quantities that come on to the market are well taken up. Makers' stocks are light, and merchants' holdings have shrunk to very small dimensions. Producers' own consuming plants continue to absorb the bulk of the output, and ironmasters report that they experience little difficulty in disposing of saleable parcels. Prices are firmly maintained, No. 1 Cleveland foundry iron being 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d., and No. 4 forge, 71s.

Hematite Pig Iron.

There is little new to report in the East Coast hematite pig iron trade. Consumers are ready to enter into further contracts at prices recently accepted, but producers refuse to entertain such offers and second-hands are inclined to hold off the market for the present in view of a likely further rise in values. Producers are understood to have disposed of more iron than they have in stock, and some manufacturers have sold as extensively as they care to commit themselves. For delivery to the end of December quotations are at the equivalent of ordinary qualities at 78s. 6d. to 79s., which is declared to be 1s. to 1s. 6d. below cost of production, but for supply over the first quarter of next year up to 81s. has been paid for ordinary qualities.

Ironmaking Materials.

Business in the foreign ore trade is practically at a standstill. Large deliveries are being received under running contracts, but consumers are not entering into new commitments. Nominally market rates remain at the level of best Rubio at 24s. 6d. c.i.f. Tees. Blast-furnace coke of good average quality keeps in the neighbourhood of 23s. 6d., delivered at the works.

Manufactured Iron and Steel.

Active industrial conditions still prevail in the manufactured iron and steel trade. Firms producing finished iron are turning out a lot of work. Semi-finished steel producers are busy and not disposed to lower prices, though they experience much difficulty in securing orders owing to the comparative cheapness of continental material. Export demand for sheets is quiet, and values are easy, galvanised corrugated sheets being £12 15s. and black sheets £10. Shipbuilding requisites are needed in large quantities and users of constructional steel are placing orders rather more freely.

Economic Coal Advance.

The latest official accountancy ascertainments relating to the coal mining industry of Northumberland and Durham indicate that, if trade were allowed to take its normal course and were not subjected to prospective changes, such as marketing schemes and quotas of production, the miners might at an early date look forward to an increase in wages. In Northumberland the figures, from an economic standpoint, are the best that have been recorded this year. The joint report of the accountants indicates that wages in December would be 33·95 per

cent. on basis rates, as compared with 27·16 per cent. in November, an increase of 6·79 per cent. The minimum additional percentage on basis wages in the county is 40; therefore, the deficiency to be made up by the owners is 6·05 per cent. The greatly improved condition of the industry is due to three causes—better prices, larger output and benefits from de-rating, which came into operation on October 1st. The report deals with the proceeds and costs of that month. Contracts at low prices which were made at the beginning of the year are rapidly becoming exhausted, and the new contracts are at prices averaging about 2s. per ton better. This will be increasingly revealed in successive monthly ascertainments.

The Coal Trade.

The general undertone of the Northern coal market is firmer and many classes show a distinct improvement in price. Contrasted with the conditions a year ago, the present outlook is much more hopeful. The economic tendency is favourable, and would doubtless continue so if allowed to be free of artificial plans to raise prices. Tonnage is coming to hand very readily, and high totals are being registered in shipments from week to week. Buyers are numerous, but many orders have been turned down and consumers have had to place business at other centres. Several cargoes of steam coal have had to be booked in Yorkshire for shipment to Australia, Northumberland and Durham coalowners being unable to take on additional business for early shipment. The steam coal trade in particular is severely restricted because of the absence of offers of supplies, either for this month or over next year. The scarcity of December supplies of steams is due to the fact that the collieries have already practically sold their output ahead, and to take further orders would necessarily lead to over-stemming. Best Northumberland steams are now at a minimum of 17s., with seconds at around 16s. Steam smalls, in common with large qualities, are held in very few hands, and prices range firmer at 11s. to 11s. 6d. for best and special brands, with 10s. 6d. quoted for seconds. There is no diminution in the strength of the steam coal trade in Durham. Here also buyers meet with little response to their inquiries and values keep high, best descriptions being 18s. 6d. and smalls 14s. to 14s. 6d. Gas coal pits are well situated. Superior qualities are at 17s. to 17s. 6d., bests 16s. 9d., while secondary grades are marked higher at 15s. to 15s. 6d., according to position. Coking coals are doing better at the recent range of prices, and bunkers are keeping steady, particularly for the better sorts. Quotations for coke are undisturbed, continuing at 27s. for gas coke, 24s. to 25s. for ordinary patent foundry coke, and 28s. to 32s. for specials. There are few sellers of gas coke, the production having been disposed of for some time forward, and the trade of other brands is on a considerable scale.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE returns from Clyde yards for November seem to indicate a falling off in the amount of work on hand. Only nine vessels of 18,648 tons aggregate were launched, which is the lowest monthly output this year to date. For the eleven months of this year the aggregate returns indicate the launching of 189 vessels of 477,161 tons total, showing a drop in tonnage of nearly 80,000, compared with the same period last year. Fresh contracts announced during November include the following:—Two twin-screw motor tankers of 13,500 tons each, for Westfal-Larsen and Co., Bergen; a cargo steamer of 7400 tons, for the Cie Nav. D'Orbigny, Paris; and two cargo steamers of 5000 and 6000 tons respectively. With a lower level of production, it appears unlikely that employment in the shipyards will show an increase over the winter months.

Steel.

Business in the steel trade continues on quiet lines. Though short time has not been mentioned, makers as a rule find it increasingly difficult to keep plants in operation. Apart from some orders for railway material, the market has been devoid of fresh interest. Home demands are as a rule on the same scale as for some months past, and the comparative scarcity of shipbuilding specifications causes considerable disappointment. The weakness on the Continent, too, is reflected in home markets. Makers of light steel sheets are turning out good quantities, but heavy sheets suffer in competition with light steel plates. Galvanised flat and corrugated sheets are not too well supported, and the home price is in the region of £13 2s. 6d. and export £12 17s. 6d. per ton. The demand for tubes has diminished and several furnaces are now inoperative.

Iron.

The bar iron trade is very dull, and practically all the works are on short time. Re-rolled steel bars are in much the same position, business being difficult to secure in face of severe continental competition. Re-rolled steel bars are now quoted £7 15s. per ton home or export, but usually a lower figure has to be accepted.

Scrap.

Supplies of scrap are now more easily secured. Prices are nominally unchanged at 72s. 6d. per ton heavy steel and 70s. per ton cast iron machinery and heavy basic.

Pig Iron.

Outputs of pig iron are small, though steady. Prices are unchanged, but the position has not improved with the importation of supplies from India and the Continent.

Coal.

The Scottish coal market is firm in all branches. Lanarkshire splints have firmed up again, with shipment to the river Plate and West Italy due this month. Fifeshire best steams are almost unobtainable at present for prompt shipment, and Lothians steams have improved their position with increasing home demands. In all districts washed nuts are a very firm feature. Aggregate shipments amounted to 300,361 tons, against 277,197 tons in the preceding week, and 213,652 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ON the whole, there has been no very material change in the conditions prevailing, either in the anthracite or steam coal section of the industry, though so far as the latter is concerned, there is evidence of collieries being better placed, as loading stems are more difficult to arrange for this side of the holidays. The tonnage has also improved. Chartering has recently been well maintained, but with tonnage coming along rather more freely, the docks are better supplied. At the end of last week there were nineteen idle tipping appliances at the various docks and only nine steamers were waiting to load, but on Monday the situation was that twenty-eight steamers were waiting to berth, whereas there were only eight berths available. There is a good prospect of loading pressure continuing throughout the whole of this month, if only tonnage comes along as expected. The demand for coals in respect of new business cannot be said to be particularly active; at any rate, it does not appear to show itself much on the open market, yet the majority of coals are finding a fairly ready outlet, except some of the large descriptions, which are somewhat irregular. So far as contract business is concerned, tenders went in this week for the requirements of the Egyptian State Railways for 165,000 metric tons of locomotive coals for delivery at Alexandria during the first four months of next year. This business is usually highly competitive, and the tendering on this occasion was no exception to the rule. The tenders were opened at Cairo on Tuesday, and reports to hand state that two firms have offered to supply the whole quantity at 28s. 4½d. per ton c.i.f. Alexandria, these being T. Beynon and Co. and Watts, Watts and Co., both of Cardiff, while it is reported that Gueret, Llewellyn and Merrett, Ltd., come next with an offer to supply part of the total quantity required at 28s. 5d. per ton c.i.f. The tenders have to hold good for ten days, so that it will be next week in all probability before it is known whether the order is definitely placed. The lowest price tendered on this occasion is 1s. 4½d. per ton less than the figure at which the railways placed their last order for 180,000 metric tons. There is also another interesting inquiry in the market, this being from the Brazilian Central Railways for 200,000 tons of steam coals, consisting of two-thirds large and one-third smalls for delivery at Rio de Janeiro over the early months of next year.

Coal Trade Audit.

The report of the joint accountants of the South Wales Coal Conciliation Board for the three months ended October last shows a trading loss of £114,560, equal to 2·43d. per ton, compared with £191,111, or 4·04d. per ton, in the three months ended July last. The economic percentage certified is 5·49 on the 1915 standard rates, as against 3·30 under the previous audit, and the colliery owners are again called upon to meet the difference between the economic percentage of 5·49 on the 1915 standard rates and the minimum of 28 on those rates guaranteed under the present agreement. There was an improvement during the past three months of nearly 2½d. per ton in the pithead prices, while wage and other costs only increased by ¼d. per ton. The revenue has benefited slightly from the decrease in tipping and weighing charges of 1½d. per ton as from October 1st. It is also pointed out that one very satisfactory feature is the increase in the volume of trade, though the industry has not been restored to a remunerative basis. There has been an increase of 10,836, or 6·6 per cent. in the number of persons employed; of 1,265,814, or 13 per cent., in the number of shifts worked; and of no less than £561,000, or 12 per cent., in the amount distributed in wages, compared with the corresponding period of last year. In view of these achievements, the colliery owners regard with grave alarm any legislative interference that would impede the continued operation of the ameliorative factors which have contributed in so marked a degree to the improved economic position of the industry in South Wales.

Engineering Exhibition.

The eighth Engineering Exhibition organised by the South Wales Institute of Engineers opened at Cardiff on Wednesday of last week and continues until Saturday of this week. It has again been a great success, the attendances being good. There are no fewer than fifty-seven stands, and while the exhibits are representative of the country as a whole, a feature is the increase in the number of local exhibitors. A tour of the hall is an education in the advance in engineering science, and on this occasion the presence of a large number of technical experts has contributed very largely to the interest and appreciation of the many visitors. Working models of colliery equipment are prominent, while in evidence also are exhibits of miners' electric lamps, explosives and blasting appliances, steam-raising plant, surveying instruments, electrical apparatus, &c., of the most modern type. The Exhibition was opened on Wednesday of last week by the President of the Institute, Professor George Knox, M.I. Min. E., F.G.S., in the presence of a large attendance.

Cardiff as Air Port.

Cardiff is taking steps to become an air port, the Finance Committee having resolved to recommend to the City Council at its meeting on Monday next that it should acquire 770 acres in the Splott area for aerodrome and other purposes for the sum of £29,000. The area abuts on the Channel, and is not only suitable for aircraft landing purposes, but also can be developed for seaplane purposes. Of the 770 acres, 290 acres are good land that can be used for allotment and building purposes and the remaining 480 acres include the tidefields and foreshore. It was decided also to approach the Board of Trade with the object of acquiring the Crown rights over the foreshore.

Depression in Spelter Trade.

At the end of last week the English Crown Spelter Company posted a notice at its works at Port Tennant stating that owing to the present position of the spelter industry the board of directors had no alternative but to close the works at the end of the year. Notice was therefore given to all works staff and workmen to terminate their contracts on Sunday, December 29th. Any person employed after that date would be on a day-to-day basis.

Current Business.

The tone of the steam coal market is a shade steadier. Tonnage delayed by bad weather is coming along more freely, and while new business is not by any means plentiful, contractors are stemming up better the balance of their current contracts. There is a prospect of collieries being actively engaged throughout the remainder of this year. Large coals are rather irregular, but dry qualities are as firm as ever, while sized and small coals are moving off well. Patent fuel is difficult to stem for any position for this month, and coke is readily absorbed. Pitwood remains round about 29s.

LAUNCHES AND TRIAL TRIPS.

DOROTHY ROSE, steel screw steamer; built by D. and W. Henderson and Co., Ltd., to the order of Messrs. Richard Hughes and Co., Liverpool; dimensions, 250ft. by 37ft. by 18ft. 6in.; to carry cargo. Engines, triple-expansion, 19in., 31in., 52in. by 36in. stroke, pressure 180 lb. per square inch; constructed by the builders; trial trip, October 31st.

KAREPO, steamer; built by Cammell Laird and Co., Ltd.; to the order of the Union Steamship Company of New Zealand, Ltd.; dimensions, 284ft. by 46ft. by 21ft.; to carry coal. Engines, triple-expansion; trial trip, recently.

CARMEN AVELLANEDA, twin-screw motor-driven ferry; built by A. and J. Inglis, Ltd., to the order of the Entre Rios Railways Company, Ltd.; dimensions, 355ft. 6in. by 57ft. 6in. by 19ft. 9in.; to carry trains. Engines, two 8-cylinder, 4-stroke, single-acting trunk type Diesel engines, Harland B. and W. system; constructed by Harland and Wolff, Ltd.; launch, November 1st.

DISCOVERY II., Royal Research Ship; built by Ferguson Brothers (Port-Glasgow), Ltd., to the order of Crown Agents for the Colonies for the "Discovery" Committee; dimensions, 232ft. by 36ft. by 20ft. Engines, triple-expansion; pressure, 200 lb. per square inch; constructed by the builders; launch November 2nd.

KITTY TAYLOR, single-screw steamer; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Eros Steamships Ltd.; dimensions, 407ft. by 53ft. 6in.; to carry cargo. Engines, triple-expansion; pressure, 180 lb. per square inch; constructed by the builders; trial trip, November 2nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

JOHN BAKER AND CO. (ROTHERHAM), 1920, Ltd., has, with the approval of the Board of Trade, changed its name to John Baker and Bessemer, Ltd.

THE HEWITTIC ELECTRIC COMPANY, Ltd., asks us to announce that Mr. A. Manighetti, A.M.I.E.E., is leaving the company to take up a position with the Sterling Varnish Company.

THE ELECTRIC FURNACE COMPANY, Ltd., of 17, Victoria-street, London, S.W., asks us to announce that it has formed and will be the sole proprietor of a subsidiary company—the Electric Resistance Furnace Company, Ltd.—to deal with the branch of its business concerned with the manufacture of electric furnaces for industrial purposes.

CONTRACTS.

VICKERS-ARMSTRONGS Ltd. has received an order from Messrs. T. L. Duff and Co., of Glasgow, for a small high-class fast passenger ship.

THE BRITISH POWER RAILWAY SIGNAL COMPANY, Ltd., has received an order from the Central Argentine Railway for signalling material required to equip the electrified suburban lines between Maldonado Junction and Tigre, a distance of 24 kilomas., with semi-automatic and automatic signals. The order includes the provision of impedance bonds, point mechanisms, two-position, lower quadrant A.C. signal mechanisms, signal posts, line and track transformers, track and line relays, &c.

JAMES GORDON AND CO., Ltd., of Windsor House, Kingsway, London, W.C. 2, have received from the Hull Corporation Electricity Department an order to install a complete system of Hagan automatic boiler control for the five Clarke-Chapman boilers in its new boiler-house. Each boiler has a normal evaporation of 80,000 lb. of steam per hour at a working pressure of 400 lb. per square inch. The equipment is to be designed to control both fuel and air supply in accordance with steam demand. The air supply will be controlled from a master regulator, sensitive to variations of steam pressure, by means of dampers at the forced and induced draught fans. The fuel supply will be similarly controlled from the master regulator by regulating a speed of the stoker motors.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, December 2nd, Sir Robert Robertson, Treasurer and Vice-President, in the chair. On behalf of the members, Sir James Crichton-Browne presented to Mr. Henry Young, late assistant secretary, a silver rose bowl and cheque on his retirement after fifty years' service in the Institution. Mr. C. F. Burgess, Mr. J. G. Crowther, Dr. E. L. Kennaway, Mr. E. H. Selby, Mrs. L. M. Shorter, Mr. D. O. Sproule, Mr. G. Stubbs, Mr. P. J. Waldram and Mr. H. Young were elected members.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/-
(1) Spanish	24/- to 25/-
(1) N. African	24/- to 25/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 18 6	3 18 6
No. 1	3 19 0	3 19 0
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (*a*) / 4 9 6 (*b*) / 4 13 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 2 6	12 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 2 6	—
MIDLANDS—		
Small Rolled Bars	8 2 6 to 8 15 0	—
Billets and Sheet Bars	6 5 0 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	12 10 0 to 13 0 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/9 to 19/-
Block Tin (cash)	177 15 0
„ (three months)	183 15 0
Copper (cash)	71 5 0
„ (three months)	70 5 0
Spanish Lead (cash)	21 6 3
„ „ (three months)	21 7 6
Spelter (cash)	20 12 6
„ (three months)	21 0 0
MANCHESTER—	
Copper, Best Selected Ingots	76 10 0
„ Electrolytic	84 5 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	22 17 6
„ Foreign	21 10 0
Spelter	20 17 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit
Tungsten Metal Powder	3/4½ per lb.	
Ferro Tungsten	3/1½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£22 0 0	6/6
„ „ 8 p.c. to 10 p.c.	£21 17 6	6/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/-
„ „ „ 1 p.c. carbon	£39 0 0	15/-
„ „ „ 0·70 p.c. carbon	£41 0 0	15/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home	
	£13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 7/- per unit	
„ Vanadium	12/10 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	16/6
„ „ Splint	16/9 to 18/-
„ „ Trebles	17/-
„ „ Doubles	16/9
„ „ Singles	14/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
„ „ Jewel	16/6
„ „ Trebles	17/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	14/3 to 16/6
Screened Navigation	18/- to 19/6
Trebles	18/- to 19/6
Doubles	17/- to 17/6
Singles	15/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/-
Secondary Steam	14/3
Trebles	18/-
Doubles	16/- to 16/6
Singles	14/6

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	21/6 to 23/-
Household	38/- to 51/-
Coke	27/6
NORTHUMBERLAND—	
Best Steams	17/3 to 17/6
Second Steams	16/-
Steam Smalls	10/6 to 11/-
Unscreened	13/- to 13/6
Household	25/- to 37/-
DURHAM—	
Best Gas	16/9 to 17/-
Second	15/- to 15/1
Household	25/- to 37/-
Foundry Coke	25/- to 30/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/6 to 28/-	—
Derbyshire Best Bright House	21/- to 23/-	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/6 to 20/-	—
„ „ Nuts	16/6 to 18/-	—
Yorkshire Hards	15/6 to 17/-	—
Derbyshire Hards	15/6 to 17/-	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/6 to 8/6	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	16/- to 17/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.	24/- to 24/6	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 20/-
Best Dry Large	20/6 to 21/-
Ordinary Dry Large	20/- to 20/6
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/9 to 18/3
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	14/3 to 14/6
Ordinary Smalls	13/- to 14/-
Washed Nuts	19/6 to 32/6
No. 3 Rhondda Large	20/3 to 21/-
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/3 to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	14/3 to 14/9
Foundry Coke (Export)	32/6 to 37/6
Furnace Coke (Export)	30/- to 31/-
Patent Fuel	22/- to 22/6
Pitwood (ex ship)	29/- to 29/3
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/- to 38/-
Seconds	30/- to 32/6
Red Vein	26/- to 28/-
Machine-made Cobbles	42/- to 45/-
Nuts	42/6 to 47/6
Beans	27/- to 29/-
Peas	18/6 to 19/6
Breaker Duff	10/6 to 11/-
Rubbly Culm	13/- to 13/6
Steam Coals:	
Large	18/- to 19/-
Seconds	17/- to 18/-
Smalls	13/- to 14/-
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6 Ordinary Ship, Bridge and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Production Facilities.

THE weakening of the industrial situation over most of the Continent is being reflected in this country, and there is some feeling of pessimism, which is not allayed by the continually increasing margin between imports and exports. While the consignments abroad are decreasing in value, the imports of manufactured goods and fuel continue to increase rapidly. The coal imports advanced from 20 million tons during the first ten months of 1928 to 25 million tons in the similar period of this year. The imports of manufactured goods increased by 29 per cent. Much of them, of course, comes from Germany. The feeling of apprehension is strengthened by the increasing production costs due to higher wages and heavier taxation, and to this burden will be added the charges arising from the application of the new insurance scheme, which has already been held up for six months because it seemed impossible to put it in operation. Notwithstanding the changes that have been made in the new law in order to render it acceptable, manufacturers are aware that if put into force early in the year, as intended, it will mean a further appreciable addition to production costs. They complain that these charges are placing them in an impossible position to compete for foreign trade. The Government is endeavouring to remove their fears by putting in hand a vast scheme of economical development which will have the effect of providing work and of reducing costs by improving and cheapening transport facilities. A sum of no less than 5000 million francs will be devoted, during a period of five years, to the execution of these works, which aim at providing cheap hydro-electric energy, at improving road and inland waterway communication and carrying out a complete rural equipment for the benefit of the agricultural industry. Something will also be done with the provision of raw material from the Colonies. With the public works already in hand, the engineering industries are fairly well employed, and it is hoped that the new works will continue to provide them with occupation for some years to come, at the same time that the programme for cheapening production will enable manufacturers to compete for foreign trade.

A Wagon Cartel.

The French builders of railway rolling stock have adhered to the international wagon union which is being formed with the idea of organising the locomotive and wagon building industry and placing it on a stable and profit-making basis. For some years past the situation has been going from bad to worse, when home requirements were far below the capacity of production and the price cutting for foreign business made it hardly worth securing. In France the situation has taken a turn for the better on account of the orders being distributed by the railway companies, but elsewhere there is no improvement, so that, for the maintenance of their own prices, the French builders find it desirable to join the international combination. It will include practically all the continental countries doing an export trade in wagons. The arrangement will ensure to French builders a monopoly of their own market, and their share of the foreign business annually will be a minimum of 200 locomotives, 500 coaches and 4500 trucks. The export trade will, of course, be centralised and divided up in agreed proportions amongst the different countries. Another object of the union is to adapt manufacture to foreign specifications, to standardise material and to arrange with producers for rapid delivery, so that the manufacture of wagons can be facilitated and production costs reduced.

Refuse Disposal.

With the rapid growth of the Paris suburban area many new problems of sanitation are being raised. One of the most urgent of them is the method to be employed for disposing of house refuse. The Prefect of the Seine is in favour of laying down incinerating plants in the suburban towns, but that is objected to by farmers who spread the refuse over their land for manure, and the ratepayers themselves consider that the initial expense is too high, although the companies which dispose of the refuse in this way find that it is a good investment. The revenue from the supply of electrical energy and the sale of products, over and above what they receive from the municipality for every tone of refuse burnt, leaves the companies with a satisfactory profit. Last year more than a million tons of refuse were collected in Paris. One-half of that quantity was incinerated and there was great difficulty in disposing of the remainder as manure, farmers finding that the cost of transport was too high. At the same time, the distribution of the refuse beyond the urban area is dinstinctly unsanitary, and for that reason alone the incineration process is preferred. Nevertheless, before coming to a final decision regarding the methods of refuse disposal to be recommended, a further inquiry is to be made into the various systems, notably the Beccari method, which is employed in Italy and has been experimented with at Cannes and other places in France. This consists in preparing the refuse as a valuable manure by allowing it to decompose in closed compartments.

Paris Electricity Supply.

Notwithstanding the arrangements being made for bringing current from the hydro-electric power stations at Eguzon and elsewhere, the electricity companies in Paris continue to carry out extensions with a view to supplying all the ordinary needs, which it is expected will remain at from 120 to 150 million kWh per annum for many years to come. This is criticised in some quarters on the ground that the capital involved will be greatly depreciated if, as is expected, the cost of hydro-electric current is below that generated at the Paris power stations. Nevertheless, the Société d'Electricité de Paris, which finds that its 130,000-kW power station at Saint-Denis is insufficient, has decided to construct another station of about 350,000 kW. It will begin by laying down three turbo-alternators, each of 50,000 kW. They will run at 3000 r.p.m. Steam will be raised with pulverised coal and will be admitted to the turbines at a pressure of 780 lb. per square inch and at a temperature of 450 deg. Cent.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

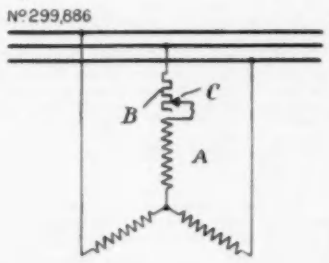
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

299,886. November 1st, 1928.—POLYPHASE ASYNCHRONOUS MOTORS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The starting of polyphase asynchronous motors by means of a three-phase starting resistance connected to the primary winding is known. The present invention has for its object a substantial simplification of this method. According to the invention, means are provided whereby, during the starting, the potential impressed on one phase of the primary circuit is made to differ from that impressed on the other phases. With respect to frequency and phase position, this potential is, of course, determined by the three-phase mains to which the primary winding is

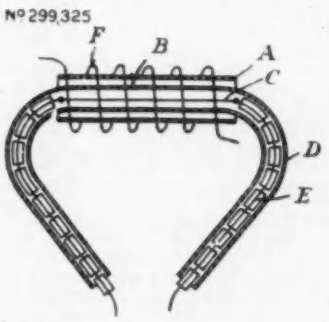


connected. The accompanying drawing shows an example of carrying out the invention. A is the three-phase primary winding of the polyphase motor, the other parts being omitted as not being important. B is an ohmic resistance with a regulating contact C. This resistance enables a potential to be given to one phase of the stator, the degree of which differs from the other potentials of the rotating field system imparted by the mains. If the third potential of the rotating field system is at zero, the motor is energised with single phase current and there is no turning moment. If the third potential is equal to the two other rotating field potentials, then the full turning moment is attained. By any desired selection between zero and the full potential the torque may be fixed at any desired value.—*October 31st*, 1929.

TELEGRAPHS AND TELEPHONES.

299,325. October 22nd, 1928.—THERMIONIC VALVES, Telefunken Gesellschaft für drahtlose Telegraphie, m.b.H., of 12/13, Hallesches Ufer, Berlin, Germany.

This invention relates to thermionic valves and more particularly to valves having so-called indirectly heated cathodes, and wherein the cathode proper is screened from the associated heating means. The invention has for its principal object to provide an improved indirectly heated cathode valve of this kind, the cathode of which may be heated by alternating current without experiencing the disadvantage commonly met with in

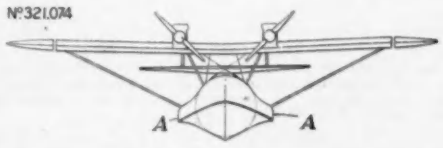


most known indirectly heated cathode valves, *i.e.*, that the alternating potential gives rise to varying grid cathode potential and thereby causes disturbances. Referring to the drawing, A indicates the active or electron-emitting cathode, B is a protecting tube insulated therefrom, and C a heating wire. Screening is provided by means of a metallic protecting tube D, which is led outside the valve envelope at both ends and which is insulated from the wire C by glass or quartz beads E. F is the control grid, which can be arranged about the glowing body in the form of a spiral.—*October 31st*, 1929.

AERONAUTICS.

321,074. November 17th, 1928.—FLYING BOATS, C. R. Fairey, Cranford-lane, Hayes, Middlesex.

An admirably phrased specification, which finishes with the following principal claim:—A flying boat wherein chines, fins

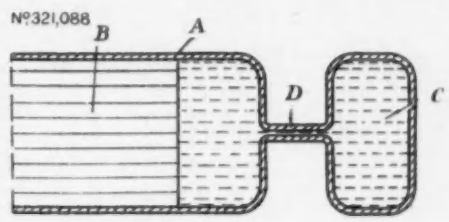


or the like are built on to the sides of the hull below the level of the centre of gravity, of such size as to accommodate the fuel supply and in such a separate manner that no fuel can enter the hull. The fins or chines are plainly shown at A A.—*October 31st*, 1929.

TRANSMISSION OF POWER.

321,088. December 7th, 1928.—FLUID-FILLED PAPER-INSULATED ELECTRICAL CABLES, William Brown, of 89, Douglas-street, Glasgow.

In connection with the manufacture of fluid-filled paper-insulated cables, it is usual, while the cable is hot, to seal the cable ends with a lead seal which is unitary with the lead cover. In practice, when the seal is broken, it is found that there is an inrush of air owing to the presence of a partial vacuum within the cable, with the result that the fluid, *e.g.*, oil or treated air, constituting the filling is caused to flow from the exposed and towards the interior of the cable and the space vacated by the fluid is filled with air, which may contain a high percentage of moisture. The invention provides an improved arrangement for

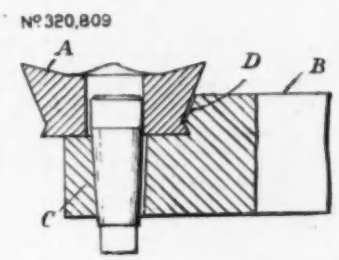


sealing the ends of such cables. Referring to the drawing, A denotes the lead cover of the cable, which is extended at each end beyond the core B so as to form at each end a reservoir C for filling fluid, the cover and the reservoir being connected by a constricted neck C which is disposed substantially co-axial with the cable. The seal may be broken by the operation of puncturing the end wall of the reservoir, whereby the fluid contents of the reservoir are permitted to flow into the interior of the cable to destroy the partial vacuum within the cable without admitting air to the interior of the cable. The neck being disposed substantially co-axial with the cable and the contents of the reservoir being considerably in excess of the fluid required to destroy the partial vacuum in the cable, there is no tendency for air entering the reservoir to pass into the cable.—*October 31st*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

320,809. December 5th, 1928.—TURNING AND BORING TOOLS, Cammell Laird and Co., Ltd., and J. Archer, Cyclops Works, Saville-street, Sheffield.

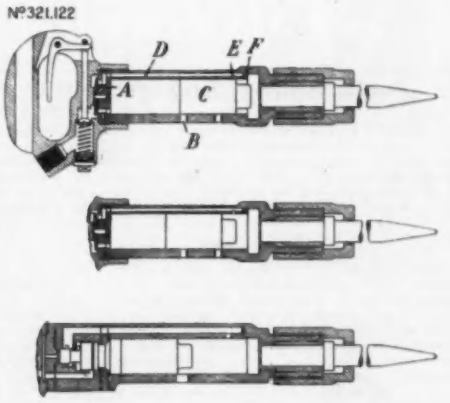
This idea virtually amounts to the securing of a loose cutter in a tool-holder by means of a pin set in two holes slightly out



of register. In the drawing the cutter is shown at A and part of the shank at B. The two are held togther by the taper pin C, which, as is shown, passes through holes in the cutter and shank so positioned that the cutter is pulled back against the shoulder D and chatter is prevented.—*October 24th*, 1929.

321,122. January 29th, 1929.—PNEUMATIC HAMMERS, G. H. T. Rayner, 14, Broomhall-road, Sheffield, and P. Rayner, 37, Ashland-road, Sheffield.

This hammer is of the disc valve type, in which the valve A responds to the sudden drop in pressure when the exhaust port B is uncovered by the piston C. The return stroke is effected by



air admitted to the front of the piston by the passage D. The peculiarity of the arrangement lies in the provision of two ports E and F connecting the passage D with the cylinder. The port F is quite small and provides only sufficient air to start the piston on its return stroke, when the port E is uncovered and the action is accelerated. In this way cushioning of the working stroke is minimised.—*October 31st*, 1929.

MISCELLANEOUS.

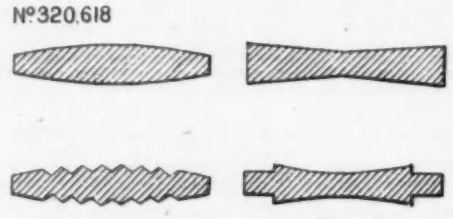
321,070. November 14th, 1928.—PROCESSES OF FIREPROOFING WOOD, A. Eichengrün, 28/33, Tegeler Weg, Charlottenburg I., Germany.

The process of this invention comprises, broadly, treating difficultly impregnatable material with an alcoholic solution containing ammonium bromide and thereafter treating the impregnated material to cause the removal of the liquid therefrom while leaving the ammonium bromide within the interior thereof. An advantage of the employment of alcohol as the solvent for the ammonium bromide is, the inventor says, that

the alcohol has a very high penetrating power and can consequently be impregnated into the wood or the like in a fraction of the time which is usually required for the normal aqueous impregnation. A further advantage is that only a low temperature is required for impregnation by the application of heat. Still a further advantage is that the wood or the like does not contain appreciable quantities of water after impregnation, but a liquid of much lower boiling point, which can be easily removed by merely raising the temperature to about the boiling point of the solvent. It is also possible to utilise for the impregnation diluted alcohol containing, for example, about 20 per cent. of water, because such diluted alcohol evaporates completely at relatively low temperatures. Moreover, the alcohol may be employed in admixture with other organic solvents, such as, for example, acetone, chlorinated hydrocarbons, furfural or suitable mixtures thereof, or in conjunction with any other solvent which evaporates at a relatively low temperature. In carrying out the invention it is preferable to effect the impregnation in a closed container and to heat the alcoholic solution of ammonium bromide in order to facilitate the impregnation, since the pressure of the vapours formed by heating in a closed container assists in driving the ammonium bromide into the wood or other material to be impregnated. After the material has been impregnated, the heating is preferably discontinued and the alcoholic solution removed, whereupon the impregnated material is subjected to a further heating, for example, at a temperature of about 80 deg. Cent., for the purpose of driving off alcohol and other liquid contained in the wood or the like material. After the solvent for the ammonium bromide has been driven out, the wood or the like material is impregnated with ammonium bromide and is thus rendered fireproof. A fireproofing agent may be made by dissolving 15 parts by weight of ammonium bromide in 20 parts by weight of water and 80 parts by weight of denatured alcohol.—*October* 31*st*, 1929.

320,618. July 12th, 1928.—PIPE JOINTINGS, The Gas Light and Coke Company, and F. Spencer, 84, Horseferry-road, Westminster.

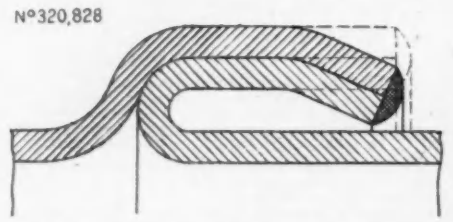
This is a most comprehensive specification and, generally speaking, it covers the means used for making tight joints between flanged pipes by means of a soft metal packing or grommett.



The peculiarity of the packing in this case lies in the fact that it is not of uniform thickness, and is either thicker in the middle of its circumference, as shown in Fig. 1, or thinner, as shown in Fig. 2. There is no definite claim in the specification as to the metal of which the packing ring may be made, but it is indicated that it should be of a soft and plastic nature.—*October* 14*th*, 1929.

320,828. JANUARY 28th, 1928.—TUBE JOINTS, Mannesmannröhren-Werke, 1B, Berger Ufer, Düsseldorf, Germany.

The "working instructions" connected with this specification are not very clear, but it appears that the general idea is to take



up the stresses within the length of the pipe by means of a socketed joint, deformed as shown, after assembly, and to ensure tightness by autogenous welding of the lips of the joint as indicated by the heavy cross-hatching.—*October* 24*th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

INSTITUTION OF CHEMICAL ENGINEERS.—Conference on Vapour Absorption and Adsorption, in the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. 10.30 a.m., papers: "The Recovery of Volatile Solvents (Brégeat Process)," by Mr. A. Hoch; "The Continuous Fractionation of Gases by Adsorbents," by Mr. J. Stanley Morgan; discussion. 2.30 p.m., papers: "Evaporation of Water in Open Pans," by Mr. G. W. Himus; "The Industrial Application of Active Carbon," by Mr. K. Evans, A.R.C.S., and Mr. H. F. Pearson; discussion.

INSTITUTION OF ELECTRICAL ENGINEERS: METER AND INSTRUMENT SECTION.—Savoy-place, Victoria Embankment, London, W.C. 2. "Alternating-current Potentiometers and their Applications," by Dr. C. V. Drysdale. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—At Armstrong College, Newcastle-on-Tyne. Debate. Mr. G. Waters will move: "That the Usual Voltage Used for Domestic Supply is Too High," and Mr. E. N. Cunliffe will oppose the motion. 7.15 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS, LONDON.—At the Manchester Literary and Philosophical Society, 36, George-street, Manchester. "Pulverised Fuel Locomotives," by Mr. J. W. Clubley Armstrong. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Informal meeting. "Diesel Engine Developments," to be introduced by Mr. W. A. Tookey. 7 p.m.

INSTITUTION OF WATER ENGINEERS.—Thirty-fourth Winter General Meeting, Session 1929–30. At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. The following papers will be taken as read, after which discussion will take place: "The Hydro-geology of the Chalk of England," by Mr. R. C. S. Walters; "Some Problems in Hydro-geology," by Professor Edgar Morton. The following Reports of the Advisory Committee on Water of the Ministry of Health will be brought before the meeting for general discussion: "Second Report of the Legislation Sub-Committee," discussion to be opened by Mr. R. J. Simpson; "Report on Rural Water Supplies," discussion to be opened by Mr. E. J. Silcock. The following Draft Report of a Sub-Committee of the Council will be brought before the meeting for consideration: "Stream Flow and Underground Water Records." 10.30 a.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Demolition of Lambeth Bridge," by Mr. A. B. Gowring. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—At the Mining Institute, Newcastle-upon-Tyne. "Cutting Capabilities of Lathe Tools," by Professor Dempster Smith. 6 p.m.

NORTHAMPTON POLYTECHNIC INSTITUTE.—St. John-street, E.C. 1. Annual prize distribution. 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "The Novel and the Creative Spirit," by Mr. Hugh Walpole. 9 p.m.

SATURDAY, DECEMBER 7TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—In the College of Technology, Sackville-street, Manchester. "Nickel in the Ironfoundry," by Dr. A. B. Everest. 4 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting to be held at Exeter. "The Local Government Act, 1929," address by Lieut.-Col. E. J. Stead. To be followed by a discussion. 3 p.m.

NORTHAMPTON POLYTECHNIC INSTITUTE.—St. John-street, E.C. 1. Annual conversazione. 6.30 to 10.30 p.m.

MONDAY, DECEMBER 9TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Melting Furnaces," by Mr. G. L. Cassidy. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "Multi-cylinder Engine Design," by Mr. L. H. Pomeroy. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—At Armstrong College, Newcastle-upon-Tyne. "The Analysis and Measurement of the Noise Emitted by Machinery," by Messrs. B. A. G. Churcher and A. J. King. 7 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, S.W. 1. "The Landlord and Tenant Act, 1927, in Operation," by Mr. W. E. A. Bull. 8 p.m.

MONDAY TO FRIDAY, DECEMBER 9TH TO 13TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Agricultural Hall, Islington, N. Smithfield Club Show. 9 a.m. to 9 p.m. daily.

TUESDAY, DECEMBER 10TH.

ILLUMINATING ENGINEERING SOCIETY.—In the Lecture Theatre at the Home Office Industrial Museum, Horseferry-road, Westminster, S.W. 1. A discussion on "Problems in Illuminating Engineering" will be opened by a series of short contributions on different subjects, including "The Lighting of Large Vertical Surfaces," Mr. A. Cunnington; "The Lighting of Operating Tables in Hospitals," Mr. E. Stroud; "A Large Gas-lighted Sign Outside Watson House," Mr. F. C. Smith; "The Lighting of the Savoy Theatre and Hotel," Professor H. Robertson and Mr. B. Ionides, and other items. 7 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—In the Lecture Room, in the Municipal College, Ormerod-road, Burnley. "Materials and Plant Used in the Manufacture of Textile Castings," by Mr. J. Pell. 7.15 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Nickel in Non-ferrous Foundry Alloys," by Mr. W. T. Griffiths. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "The Relative Safety of Mild and High-tensile Steel Under Alternating and Pulsating Stresses," by Dr. B. P. Haigh. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' meeting. Cavendish Café, Cornmarket, Derby. "Aero-engine Lubrication Systems," by Mr. P. V. Halliwell and Mr. R. N. Dorey. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Extra meeting. Lecture on "The Locomotive and Bridge Oscillation," by Professor William Ernest Dalby. 6 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Engineer in Relation to the Petroleum Industry," by Mr. John Gillespie. 5.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Spalling and Disintegration of Refractory Materials," by Mr. A. T. Green. 7.30 p.m.

WEDNESDAY, DECEMBER 11TH.

FARADAY SOCIETY AND ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—Joint meeting in the Lecture Theatre, of Northampton Polytechnic Institute, St. John-street, E.C. 1. The following papers will be discussed: (1) "The Effect of Addition Agents upon the Conductivity, Cathodic Polarisation and Grain Size of Deposits Obtained from the Cell: $Cu/CuSO_4$, H_2SO_4/Cu," by Mr. B. Clark and Mr. E. O. Jones; (2) "The Electro-deposition of Silver from Argento-cyanide Solutions," by Mr. Samuel Glasstone and Mr. Edward B. Sanigar. 8 p.m.

INSTITUTE OF FUEL.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "The Coal Burning Art as Applied to Steam Production," by Mr. W. D. Wylde. Owing to the author's absence abroad, the paper will be presented and the discussion replied to by Mr. H. L. Pirie. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Birmingham Graduates to the works of the Austin Motor Company, Ltd., Northfield. 2.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Informal Meeting. Subject for discussion:—"The Heating of Buildings by Electricity off Supply Mains, with special reference to the Problem of Heat-Storage and Off-peak Loads," by Mr. Arthur Henry Barker. 6 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, E.C. 4. "Pumps and their Selection for Various Duties," by Mr. E. B. Tait. 7.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Northern Ireland District meeting at the Municipal College of Technology, Belfast. A paper and discussion on "Town Planning," by Mr. R. B. Donald. 6.45 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: LUTON, BEDFORD AND DISTRICT SECTION.—At the Royal Hotel, Mill-street, Luton. Inaugural meeting of the Section. Short addresses by prominent Members of Council. "Progress in Manufacturing Methods," by Mr. J. H. Garnett. 8 p.m.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—In the Club Room, Royal Agricultural Hall, Islington, N. 1. Annual general meeting. 2.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Overheads and other Factors Influencing Road Transport Costs, from an Engineer's Viewpoint," by Major Charles Wheeler. 8 p.m.

THURSDAY, DECEMBER 12TH.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—85–88, The Minories, E.C. 3. An informal meeting of student graduates and graduates, "What is Expected of a Junior Engineer on Joining his First Ship," by Mr. J. R. Douglas. 6.30 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Die Casting," by Mr. A. H. Mundey. This paper forms part of a joint programme arranged by the Birmingham Metallurgical Society, the Staffordshire Iron and Steel Institute, and the Birmingham Local Section of the Institute of Metals. 7 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Joint meeting with the Institute of British Foundrymen, in the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "Metal Melting by Electricity," by Mr. D. F. Campbell and Mr. W. S. Gifford. 7.30 p.m.

INSTITUTE OF PATENTEES.—Caxton Hall, Westminster, S.W. 1. "Inventions as an Aid to Health," by Sir Wm. A. Lane, Bart. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Joint meeting with the Institution of the Rubber Industry, Grand Hotel, Birmingham. "The Mechanical Properties of Rubber," by Mr. A. Healey. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: LONDON GRADUATES.—Watergate House, Adelphi, W.C. 2. "Repairs," by Mr. C. A. Partridge. 7.25 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. "Experimental Solution of Practical Hydraulic Problems with Special Reference to the Use of Models," by Capt. H. W. Coultas. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Joint meeting with the British Section of the Société des Ingénieurs Civils de France, in the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "The Electrical Plant and Network of the Société Electrique de la Sidérurgie Lorraine," by Messrs. L. A. E. Sekutowicz and A. Evain. 6 p.m.

INSTITUTION OF WELDING ENGINEERS.—At Caxton Hall, Westminster, London, S.W. 1. "The Fusion Welding of Unfired Pressure Vessels," by Mr. L. W. Schuster. 7.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: TEES-SIDE BRANCH.—Bolbec Hall, Newcastle-upon-Tyne. "Modern Constructional Steel Work," by Mr. N. J. Lunam. 7.30 p.m.

OPTICAL SOCIETY.—At the Imperial College of Science and Technology, Imperial Institute-road, South Kensington, S.W. 7. "The Insensitivity and Personal Equation Errors of Optical Settings," by Mr. J. Guild. Exhibits and demonstrations. 7.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Development of Material for Aircraft Purposes," by Dr. W. Rosenhain. 6.30 p.m.

SOCIETY OF CHEMICAL INDUSTRY: CHEMICAL ENGINEERING GROUP.—Joint meeting with the Bristol Section. Visit to the Avonmouth Factory of the National Smelting Company, Ltd. 2.30 p.m. In the Chemical Department of Bristol University. "The Treatment of Flotation Concentrates Preparatory to Zinc Smelting," by Mr. Stanley Robson. 6.30 p.m.

FRIDAY, DECEMBER 13TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—Crystal Palace, S.E. 171st Award of Certificates. 3 p.m.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Caxton-street, Westminster, London, S.W. 1. "A Form of Coupling for Geared Diesel Engines for Land and Marine Purposes," by Mr. W. Grose. 3.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department, The University, St. George's-square, Sheffield. "Physical Testing," by Professor F .C. Lea. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Scottish Graduates to the works of G. and J. Weir, Ltd., Cathcart. 7.45 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Trend of Development in Railway Signalling," by Capt. B. H. Peter. 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. "Bearings for Line Shafting," by Professor G. F. Charnock (Member of Council). Professor Charnock died on November 7th, and his paper will be presented by Mr. F. Wigglesworth. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. Presidential address, "Some Engineering Difficulties and how they were Overcome," by Sir Ernest W. Moir, Bart. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Informal meeting in the Institution Library. Subject for discussion, "Is Sea Experience Essential in Order to Become a Good Marine Engineer?" to be introduced by Mr. Edmund Wilson. 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "Cave Excavation in the Near East," by Miss D. A. E. Garrod. 9 p.m.

MONDAY, DECEMBER 16TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES.—Informal meeting at the College, Loughborough. Short papers and discussions. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Meeting. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, S.W. 1. "Calculating Machines," by Mr. C. G. E. Dahl. 7 p.m.

TUESDAY, DECEMBER 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' meeting, Broadgate Café, Coventry. "Modern Aero-engines," by Mr. Clark. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Queen-street, Wolverhampton. "The Super Sports Motor Cycle," by Mr. J. Wallace. 7.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Stress-strain Diagram," by Mr. L. H. Evans. 7.30 p.m.

WEDNESDAY, DECEMBER 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' meeting, Queen's Hotel, Birmingham. "Front Wheel Drive," by Mr. N. Bland. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Victoria Hotel, Wolverhampton. Annual dinner and dance. 7.30 p.m.